THE RESOURCE VALUE OF INDIGENOUS PLANTS TO RURAL PEOPLE IN A LOW AGRICULTURAL POTENTIAL AREA

BY

ANTHONY BALFOUR-CUNNINGHAM

Submitted in partial fulfillment
of the requirements for the degree of
DOCTOR OF PHILOSOPHY
in the
Department of Botany
Faculty of Science
University of Cape Town
1985

DATE DUE

ERRATUM

Due to misnumbering, p.224 has been numbered as pp.224-234.

DEDICATION

To my late grandfather, "Zithulele", for initiating my interest in the Ingwavuma district; to my father for teaching me to observe; and to the people of KwaMhlab'uyalingana for sharpening my perception and enabling my idea for this study to become a reality.

MHLAB'UYALINGANA

B R GWALA

Ngithule ngingalele,
Ngicabange ngingazelele,
Ngahlaziya ngaphumelela,
Anginakuthulake ngingabingelelanga,
Kuwe mhlab'uyalingan'ungizele.

Ekusen'ulal'izinkungu,
Ube muhl'undizw'amalanda,
Ngimangale ngim'obonjemi,
Ngikhex'umlomo ngalobo bungcweti,
Akubeka ngab'umdali.

Uthul'uthe nabalala,
Wendlaleka qede ngafika,
Ngithe ngingafika ngenaba,
Namuhla ngingumsintsi wokuzimilela,
Nginanel' izithelo zobuhle bakho.

Ngisakh'umkhanya ngakuhleka
Ngith'ugcwel'ubuthonga,
Ngingaz'ugcwel'ubusoka,
Manj'anginakumelana nawe,
Ngob'ulingana nje uyisoka lamasoka.

Namuhl'uheh'izindimbane,
Engizibona zehla zenyuka eSodwana,
Zichutha kuw'amanon'akho,
Zibone konke kukusha,
Namuhl'udunyisw'okungesunyukuphela.

Wo! He! Ngikhohliwe ngekhuzubhayi.
Lapho ngibon'umhlola wendalo yakho,
Ngihlale phansi khilikhithi.
Nginanele lobo buhle oyibo,
Kimi awusapheli nasemaphusheni.

Njengomama ngaqhibuka kuz'izihlabathi,
Ngancela lolohlaza lwemvelo kuwe,
Ngingakushiya ngithi ngiyaphi.
Ngoba njengethonga sengiphezu kwamakhanda,
Angisenakudilizwa ngiyadlondlobala.

Mhlab'uyalingana man'isibindi,
Wawushaywa luval'ungenamviki,
Namuhl'uzal'amaqhawe ngeviki,
Avuk'abamb'izikhali nqqi.
Abhekane nalow'ongakuthi hlwi!

Amagam'am'asenokuba lula,
Senokuthi ngilahl'inqgikithi.
Inqgond'isenokuba buthuntu,
Senokuthi ngilahlekelwe yimicabango.
Nakuba kunjalo, mhlab'uyalingana,
Lesi yisikhumbuzo sami.

MHLAB'UYALINGANA*

B R GWALA

When I'm quiet and sleepless,
Thinking unexpectedly,
I examined you successfully
And I cannot be quiet without saluting
To you Mhlab'uyalingana as you fathered me.

You're so misty in summer mornings
So beautiful when white egrets fill your sky
You surprise me when I'm on Ubombo mountain
I can't be quiet about your perfection
In which the Lord created you.

You're so silent and flat,
Flattened before I arrived
Today I'm happily rooted,
Indigenously anchored
Enjoying the fruit of your beauty.

Previously I laughed at you
Thinking you full of Thongaism
While in reality you are filled with richness
Now I can't stand against you
For your flatness is attractiveness.

Today you're attracting the multitudes
I watch them flocking up and down at Sodwana
Picking from your fat,
Things seem newly born
Now you're worshipped indefinitely

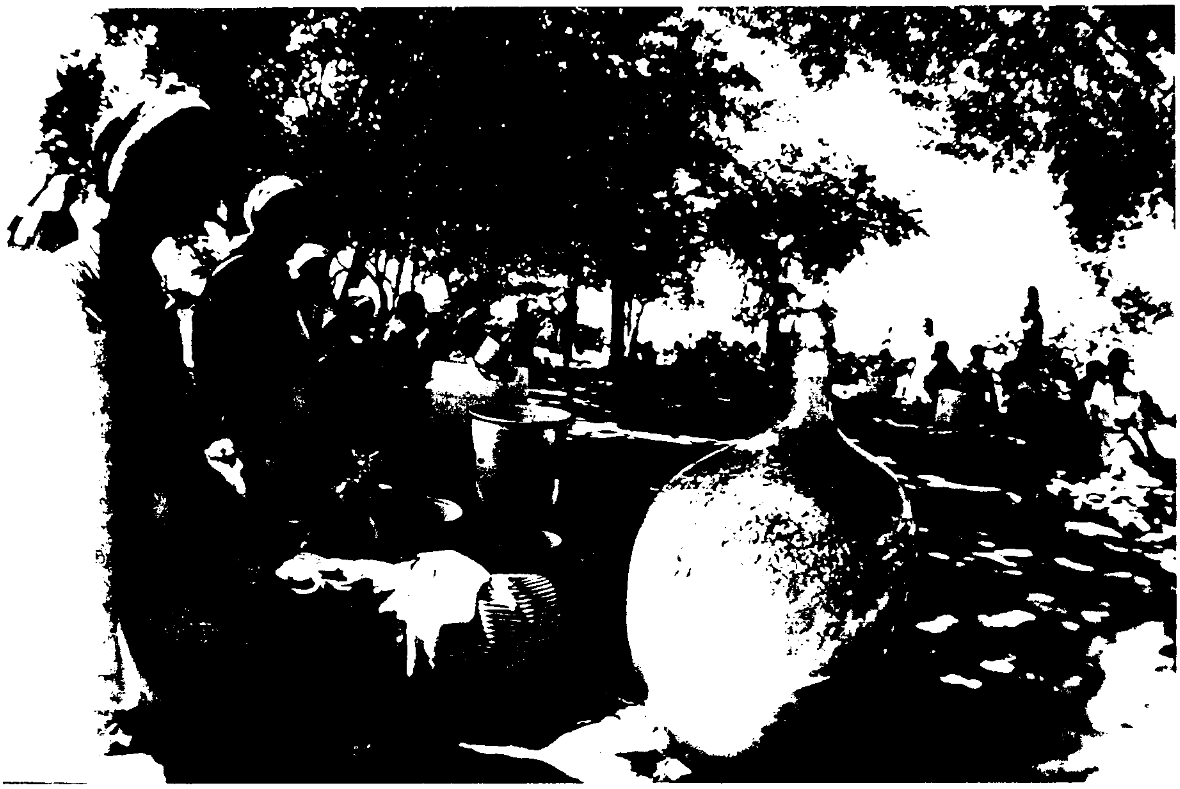
I won't forget Makhuza's Bay
Where I see the magic of your creatior
Where I sit down stunned
In appreciation of your beauty
To me you shall never perish, even in

As from a mother I sprouted from that
I suckled from that green nature you'v
In fact where can I leave to?
For as a Thonga I'm above the heads
I shall never be diminished

Mhlab'uyalingana be brave
You were so scared without a protector
Today you are fathering heroes in weeks
Who wake up and grab their weapons
And face who ever tries to snatch you

My words may be superfluous
My mind may be dull,
And my thoughts may wander.
However Mhlab'uyalingana is my memoir

* The Zulu name for the Maputaland coastal plain, literally "flat earth" (umhlabathi = earth, uyalingana = level or flat).



CONTENTS

PREFACE

In common with many people, I have long been fascinated by the beauty of the Maputaland scenery and its vegetation. First stimulated by stories about the area told me by my grandfather (a magistrate in the Ubombo and Ingwavuma districts in the 1930's), this interest grew with visits to Mkuze and Ndumu Game Reserves during the 1960's and on trips to the area in 1974, 1975 and 1976 as a student.

Insight into indigenous vegetation in this area (which indirectly grew out of an interest in insects) has been stimulated by many people. Mike John and Rob Scott-Shaw on early field trips (1974, 1975). Peter Goodman and Jeremiah Gumbe during vacation employment as a student in Mkuze Game Reserve (1975, 1976) where I first started learning the Zulu names and uses of indigenous plants found in the study area. Ken Tinley, Eugene Moll, Dave MacDevette and Robert Gwala gave particularly stimulating input when I came to live in the area in 1980, sharpening and broadening my ideas for this study. Communication with Robert Gwala, Pam McLaren, Alford Ntombela, Mlingo Gwala, the late Amon Vilane and other members of the Bureau of Natural Resources was particularly valuable in the years that followed. Also too was the input from numerous other people in the study area, during informal discussions or interviews.

Ken Tinley and Willem van Riet's visits to the area resulted in the report "Tongaland : Zonal Ecology and Rural land-use proposals" (1981). The approach and scope of this report detailed the ideas discussed by Ken Tinley when my study started (1980). It therefore provided a valuable standard against which I could evaluate my own observations and the frustrations of seeing many of my own ideals crushed against the reality of their implementation. Many people (sometimes inadvertently) have played negative or positive roles in this by illustrating the gap between plans and practical implementation, particularly in the Department of Cooperation and Development, the KwaZulu Departments of Agriculture and Forestry and the KwaZulu Department of Works as well as the Tembe Tribal Authority and the Bureau of Natural Resources. I am indebted to them for a valuable lesson.

I would also like to thank the Director, KwaZulu Bureau of Natural Resources for permission to do this project and to the Co-operative Scientific Programmes Section of the Council for Scientific and Industrial Research, the Harry Oppenheimer Institute of African Studies and the Wildlife Society of Southern Africa for the funding to enable its completion.

I am also particularly grateful to my parents, to Ricky and Wendy Taylor, Charles and Ailsa Walley and Flip and Rina Botha firstly for their hospitality and the opportunity to escape for a while from the isolation of the study area and secondly for their patience whilst I blew off steam and frustration.

Finally I would like to acknowledge my supervisor, Professor Eugene Moll of the University of Cape Town for his encouragement, enthusiasm, and willingness to help, Peter Norton and Craig Hilton-Taylor for their comments on various sections of this thesis, and Sally Creed for her excellent typing.

GENERAL INTRODUCTION

This is essentially an ethno-botanical study that explores the borderland between nature conservation, plant use and people.

The study area is situated at the southern end of the large coastal plain stretching down the east coast of Africa from Somalia to Natal, South Africa. Roughly rectangular in shape, and 1 900 km^2 in extent, it forms a major part of an area known as Maputaland or Tongaland in Natal/KwaZulu (Figure 1). Since this study was initiated, Bruton and Cooper (1980) and Tinley and van Riet (1981) have synthesised the available information on Maputaland. This provides an excellent background to the climate, geology, natural resources, history and development of the study area. Mapping of amenities, soils, vegetation, geology, agricultural development and potential has been done on a 1:100 000 scale by Loxton et al, 1969. These data were used as a basis for smaller scale maps by Tinley and van Riet (1981) who also provided detailed descriptive information on climate, soils and ecology of the area. Because of these previous studies and the fact that the book by Bruton and Cooper (1980) is readily available descriptive detail has been kept to a minimum and is summarised in the series of Figures 1-17.

This thesis is split into sections (A-L), each with a summary and introduction. To avoid repetition I will firstly, state the aims of the study, secondly, outline why the study was done, thirdly, summarise descriptive information on the study area and fourthly, give a more detailed historical background to the people-plant interactions in the study area.

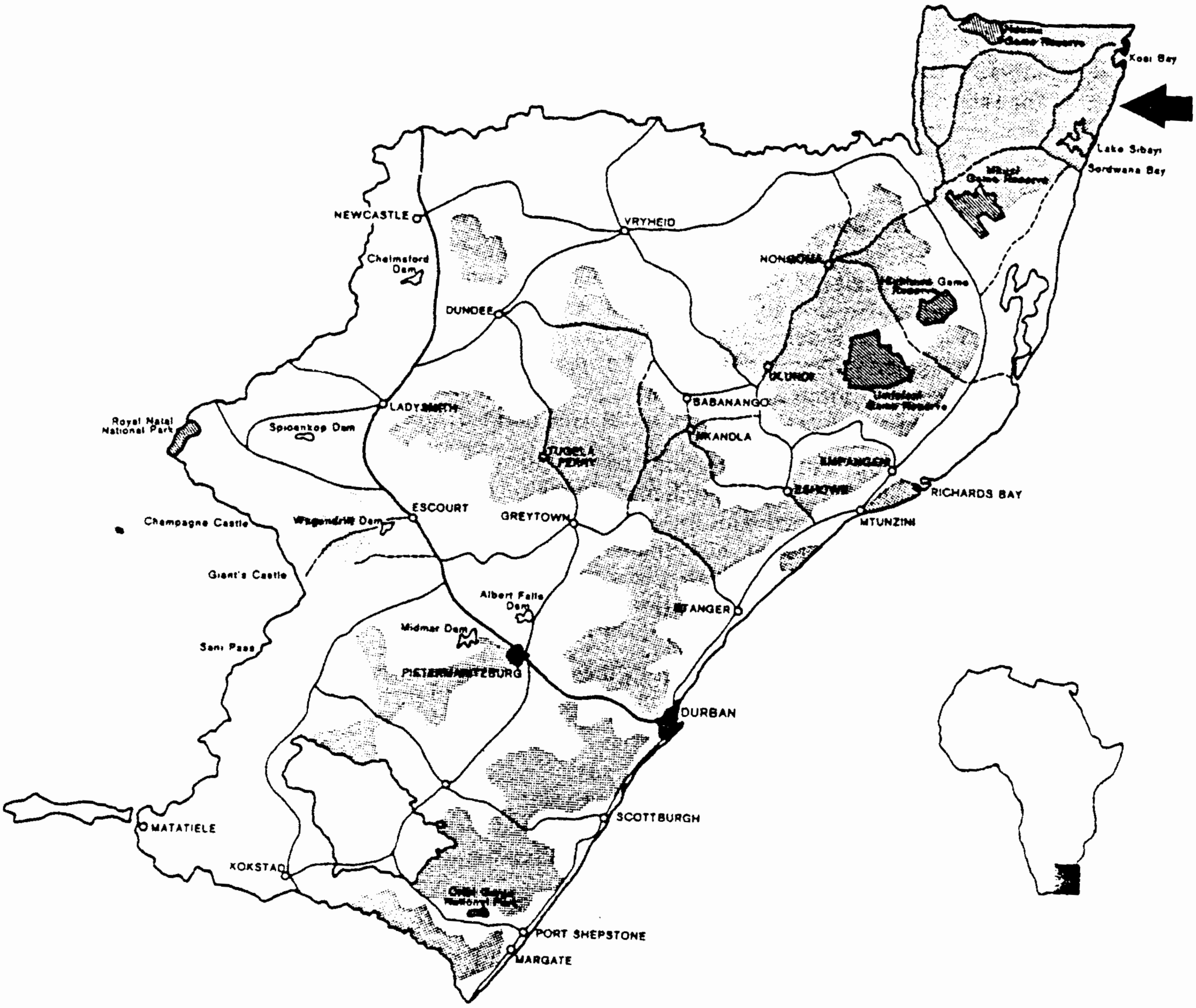


Figure 1. The location of Maputaland in the context of Natal and Kwa Zulu (grey areas) showing the location of proclaimed nature reserves at the start of the study (from Ferrario, 1981).

AIMS

aims of the study were to :

Record plant species used for hut-building, palm wine tapping, craftwork, fencing, food and drink, firewood and fish-kraals.

) Evaluate the nutritional, economic and utilitarian value of these species.

ιi) Put forward management proposals to allow a compromise between conservation and the aspirations of the local people through controlled use of certain plant resources within the area.

.eldwork was done from June 1980 to September 1983 while I ived in the area. The approach to the study is outlined in ection A.

WHY?

Maputaland (Figure 1) could quite easily take the cake for being the most researched rural area in southern Africa. The distinction is a dubious one. Many conservation managers, frustrated by an excess of research proposals and little tangible contribution to conservation or development in the area would e quite entitled to throw up their hands in horror and ask hy yet another research project? Why not less talk, less esearch, and more progress on the ground?

: had five main reasons for doing the study.

Firstly, it was ironic that in spite of all the scientific studies carried out in the area that illustrate how unique it is, and the fact that conservation/development conflicts relate directly to human needs and numbers, the people-conservation interaction has been neglected as a research topic by biologists. In fact this is a general problem in Africa that clouds insight into conservation problems. As Ferrar (1983) put it, "nature conservation is a human activity for human purposes with the natural environment as it's stage. Why have the conservation researchers been so reluctant to focus on people?" With imminent plans for conservation (Figure 18) and development in the area, research on the conservation - plant use - people interaction was needed to fill part of this gap.

Secondly, even where the conservation - people clash was comparable and had been recognised as a threat to conservation areas, indigenous plants had received little attention. Huntley (1978) has pointed out that "perhaps the most important recent advance in conservation thinking in the African context has been the realization that the active and economic participation local human populations is essential to the long term planning any national park". Yet with few exceptions, the main themes ed in justifying conservation as a form of land-use to African liticians or rural peasants have been "profit, protein, pride .d prestige" (Huxley, 1961) and not plants.

ıirdly, there was a need for quantified work on the people plant interaction. Ethnobotanical studies in southern Africa ave been limited mainly to recording the uses of plant species .nd their vernacular names (Liengme, 1983). Notable exceptions ,ere the excellent study by Quin (1959) that quantified food intake and dietary habits of the Pedi, a study of firewood use by Best (1979) and studies by Gandar (1983) and Liengme (1983a) on wood use.

Fourthly, there had been rejuvenated interest in the potential value of indigenous plants in development programmes of developing countries (NAS, 1975, 1979). Maputaland is an area with a high species diversity and a wide range of habitat types. An estimated 40% of the woody vegetation is endemic while non-endemic or linking species are associated with several other major phytochoria (Moll and White, 1978). A thorough ethno-botanical study would therefore have the added value of recording "traditional knowledge" of indigenous plants that are potentially valuable for use in the area or in other low agricultural potential sub-tropical areas.

Fifthly, I had an interest in the subject, was familiar with the area and could understand Zulu. Without the interest in people, conservation and plants I would have been overwhelmed by the adverse working conditions, the isolation and the mounds of bureaucratic red-tape. I would also have made the mistake of rushing into the study rather than going through the scatter of long meetings with the Tembe Tribal Authority and rural people concerned with the project that spread over the 15 month period prior to quantitative monitoring. As it was, the study nearly did not get started because my project proposal was rejected by the university institute I thought most likely to accept it.

THE STUDY AREA

Climatic bands, geological and geomorphic features and vegetation types of the study area all occur in longitudinal strips parallel to the coast (Figures 2, 4, 5), resulting in four ecological zones running north-south down the sandy coastal plain (Figure 5).

Climate

Climate and soils are the most important factors influencing the biotic component in the study area. Schultze (1965) describes the climate as warm to hot, humid sub-tropical. Winters are drier than summers, although rain is received

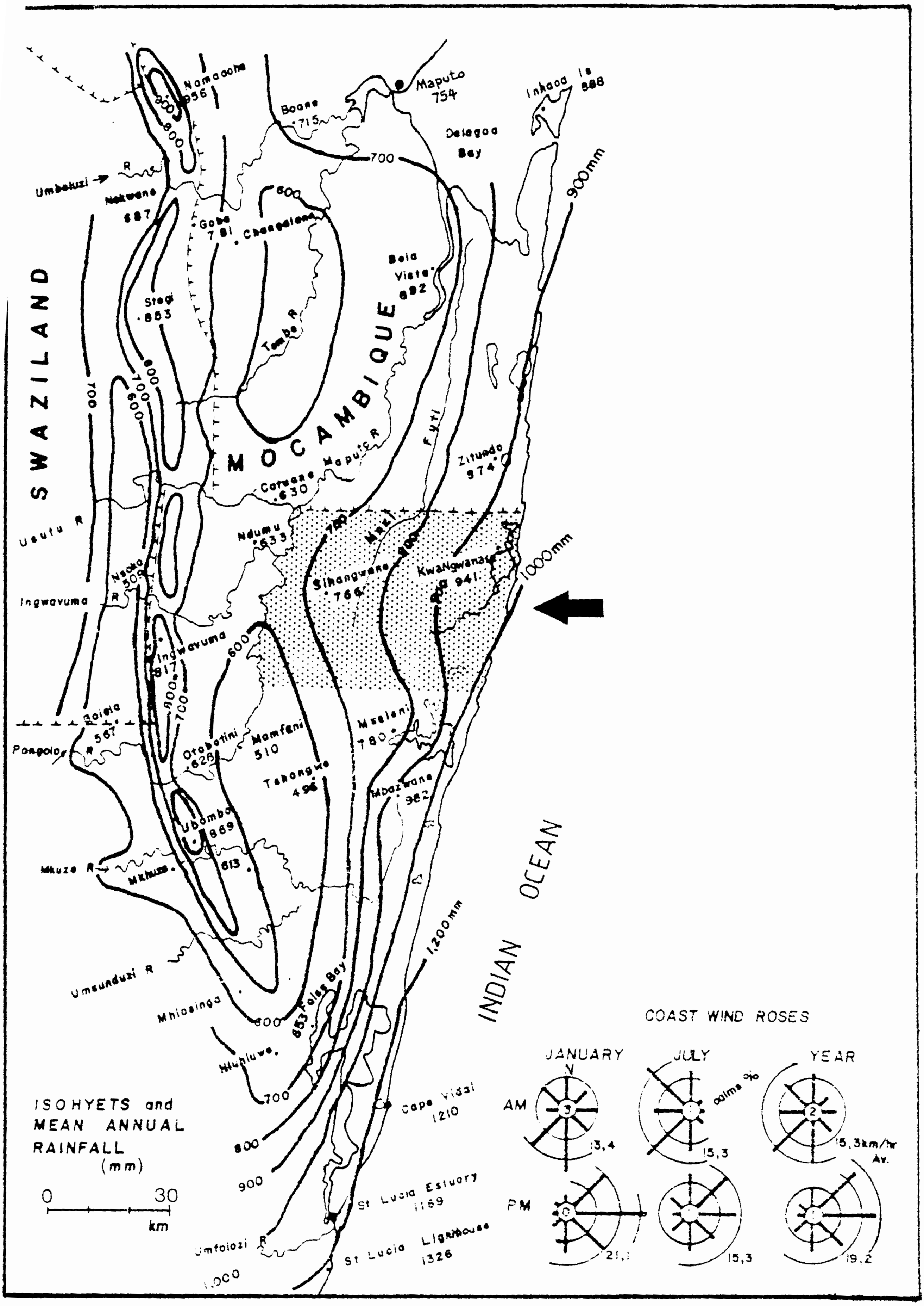


Figure 2. Isohyets and mean annual rainfall of the Mozambique coastal plain, including the Maputaland area. Wind roses shown are wind records from Maputo (from Tinley and van Riet, 1981). The study area (shaded) is indicated by the arrow.

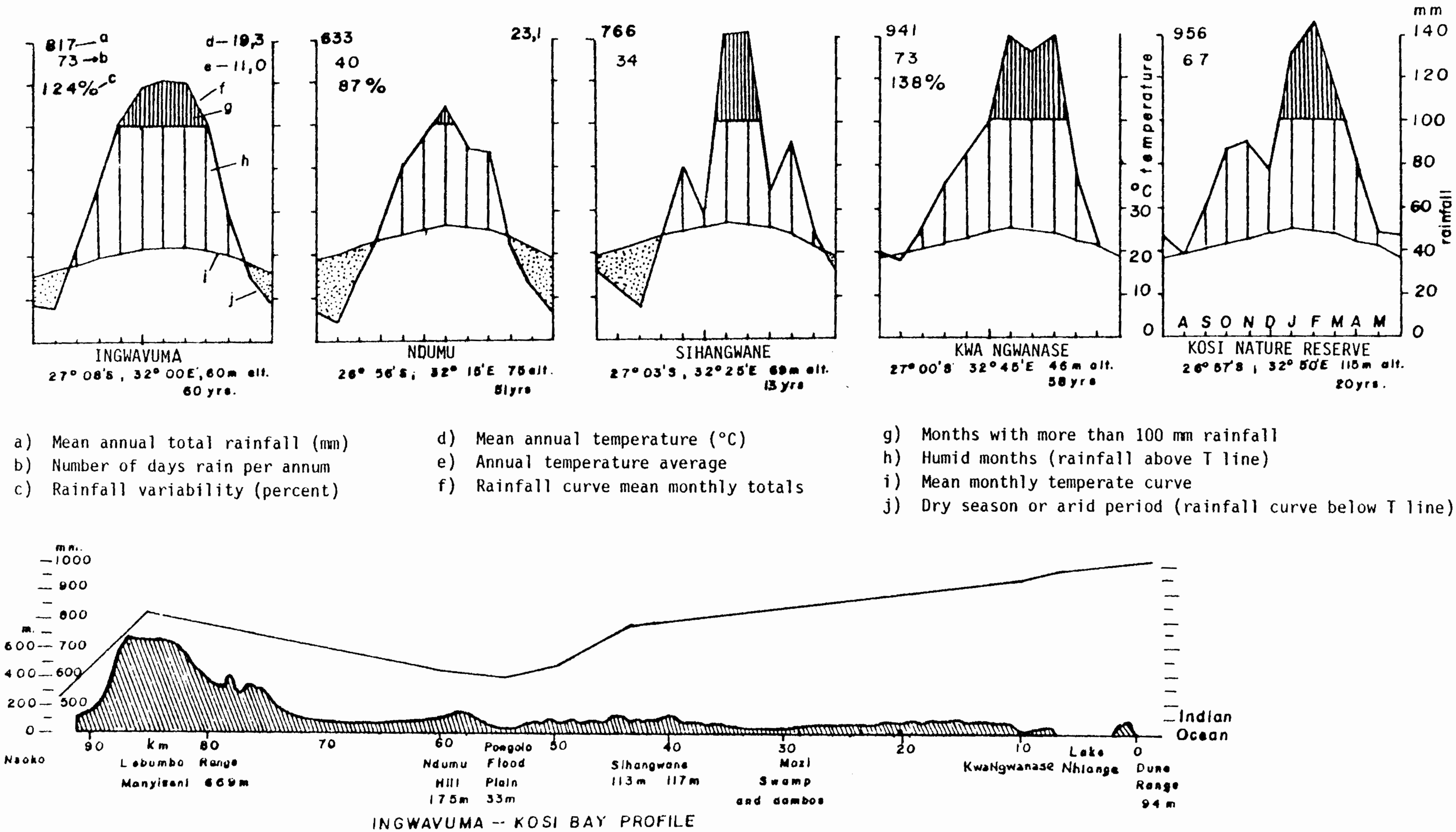


Figure 3. Climate and relief profile across the Ingwavuma district (from Tinely and van Riet, 1981). The study area lay between the Pongolo floodplain and the Indian Ocean.

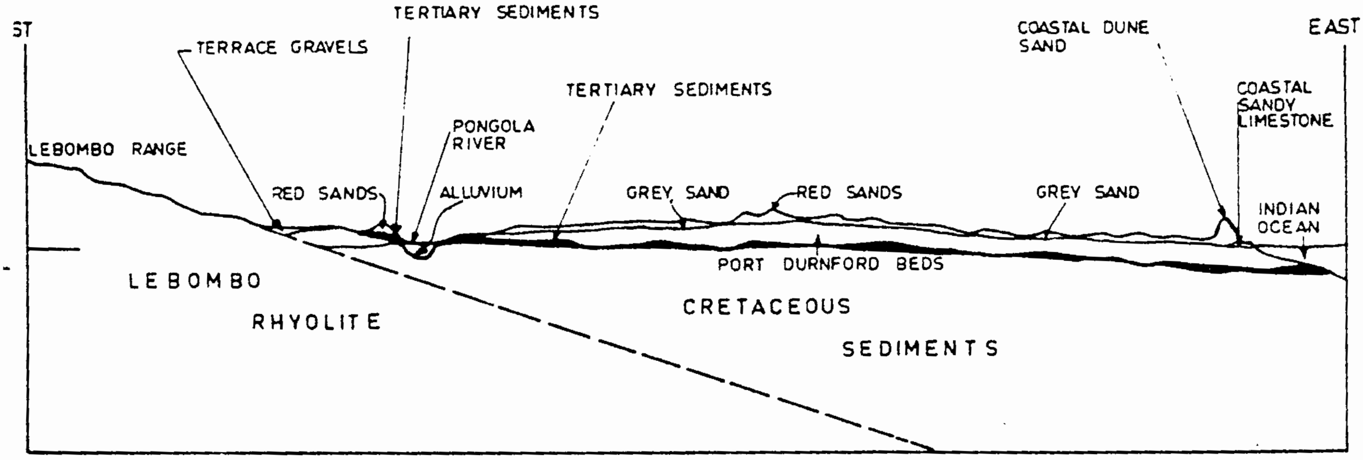


Figure 4. Schematic geological cross-section of Maputaland (not to scale) (from Maud, 1980).

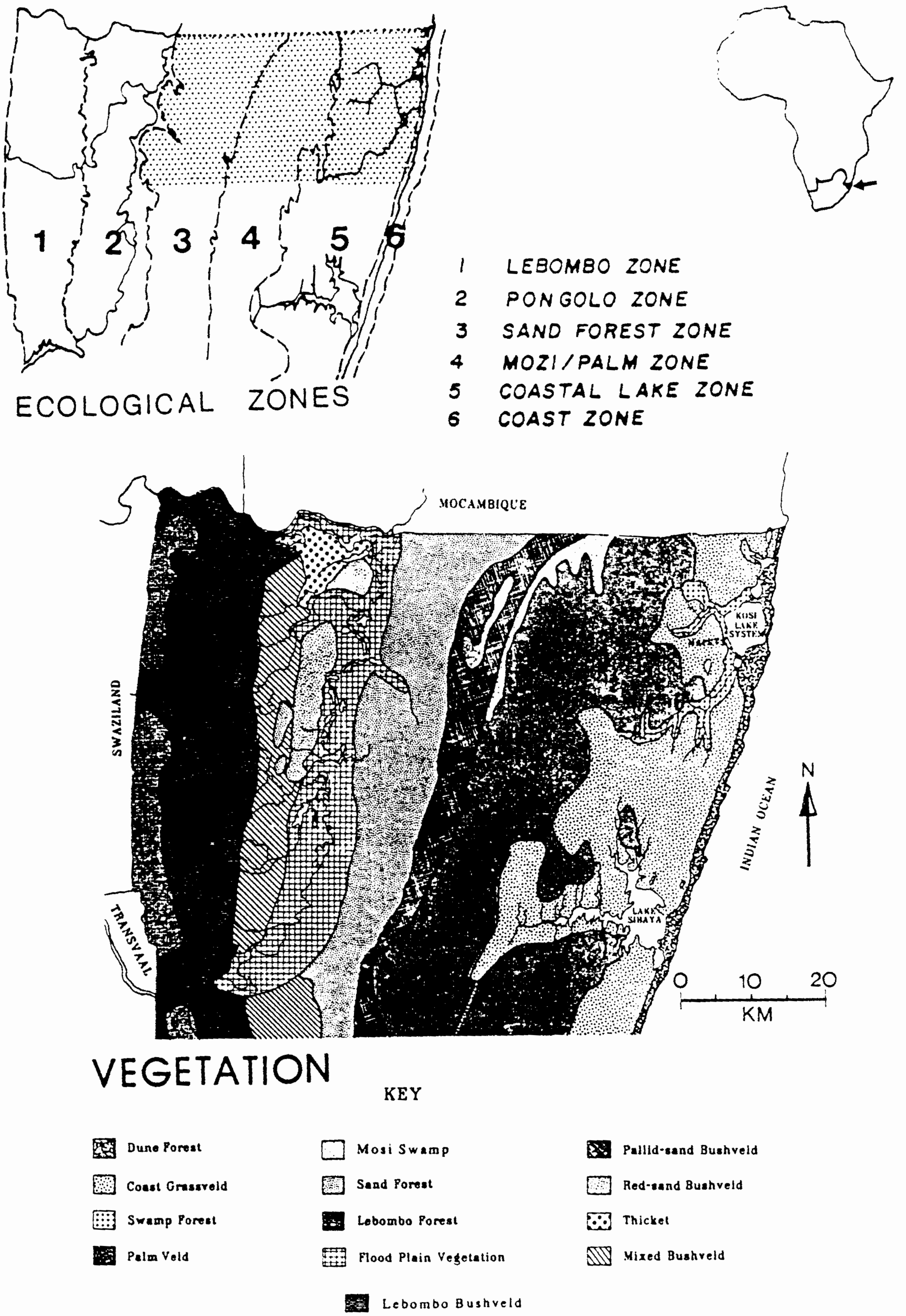


Figure 5. Ecological zones (Tinley and van Riet, 1981) and basic vegetation types (Moll, 1978) of the study area (shaded in upper figure).

roughout the year. Rainfall is highest at the coast 000-1 100 mm annually), declining progressively inland to 0-700 mm annually at the western border of the study area d then increasing to about 800 mm annually on the Lebombo ountains (Maud, 1980; Tinley and van Riet, 1981) (Figure 3). ata on relative humidity, wind, insolation and temperature xtremes are summarised by Tinley and van Riet (1981).

eology, Geomorphology and Soils

Dunes of late Pleistocene or Recent age overlie coastal sandy limestones or Port Durnford Beds on the flat, low-lying coastal plain (Maud, 1980) (Figure 4). Davies (1975) has identified at least six cordons of red dune-sand on the Maputaland coastal plain in addition to a large number of lower and shorter dunes of brown or yellow sand. Each dune cordon probably lay adjacent to Pleistocene shorelines. The highest red dune cordon (130 m. asl) lies in the Sand Forest Zone and is clearly distinguishable due to its cover of Sand Forest/Thicket (Figure 15). The Mosi-Palm Zone to the east of this comprises low lying, high water table sands (70 m asl) while the Coast Zone is higher lying with gently rolling pale sandy plains and a red dune ridge near Kwa Ngwanase. The present shoreline is lined by a high coastal dune ridge. The Kosi Lake System lies adjacent to this dune ridge. The lake system (with a depth of 33 m), was probably formed in submarine canyons eroded into the Port Durnford Beds exposed by the receding sea level and blocked ıff by the formation of this longitudinal dune ridge (Tinley ınd van Riet, 1981).

The sandy soils of the coastal plain are leached, infertile and have a low agricultural potential (Figure 5). The oldest dunes, characterised by weathered red sands have a slightly higher clay content and a higher agricultural potential but are not irrigable (Figure 7). Interdune areas are characterised by a high water table and seasonal or permanent waterlogging.

VEGETATION

These sandy soils are stabilised by a covering of vegetation which changes markedly with topography and soil type. Phytogeographically the study area lies in the Tongaland-Pondoland Regional Mosaic (Figure 8) and has a high proportion of endemic species (Moll and White, 1978). The ecological zones of the study area are reflected in the major vegetation zones covering the coastal plain (Figure 5). However this broad classification obscures the smaller scale changes that occur firstly, due to topography and soil type and secondly, due to the influence of man (fire, agriculture, cattle). These are shown on large scale vegetation maps of the whole area (Loxton et al, 1969 1:100 000)) and of the Coast Zone (Tinley, 1958 1:36 000; MacDevette (1981) 1:50 000).

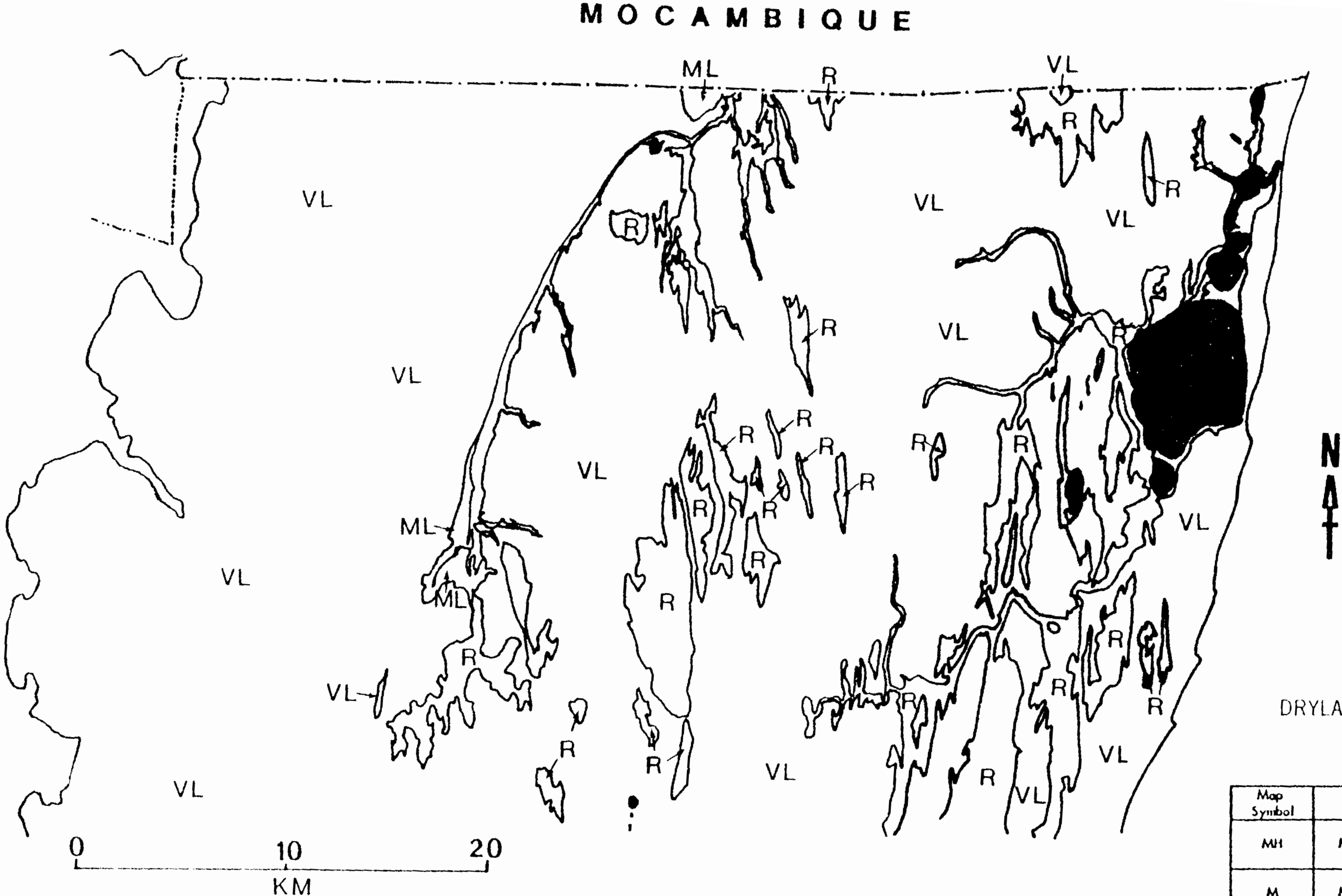
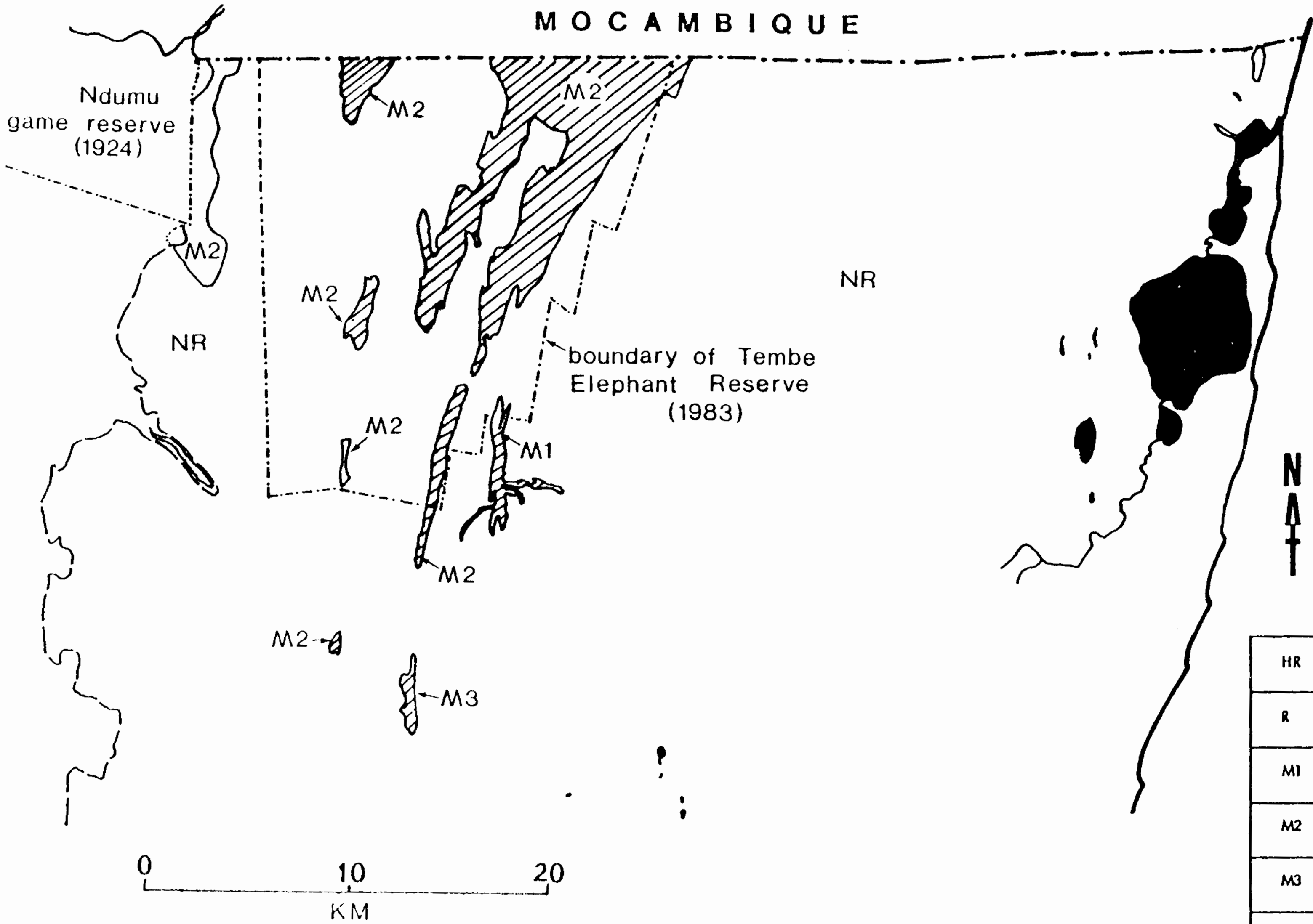


Figure 6. Dryland arable production potential of the study area (subsistence crops) (from Loxton et al, 1969).

DRYLAND ARABLE PRODUCTION POTENTIAL

SUBSISTENCE CROPS

Map Symbol	POTENTIAL
MH	Moderately high
M	Moderate
ML	Moderately low
L	Low
VL	Very low
NA	Physically Non-arable (other areas may include limited areas of non arable soil)
R	Areas of very limited potential other than a possibility of paddy rice



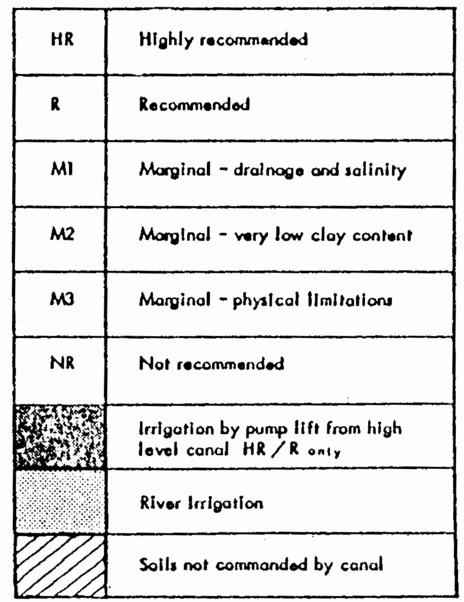


Figure 7. Provisional assessment of the irrigation potential of the study area (from Loxton et al, 1969).

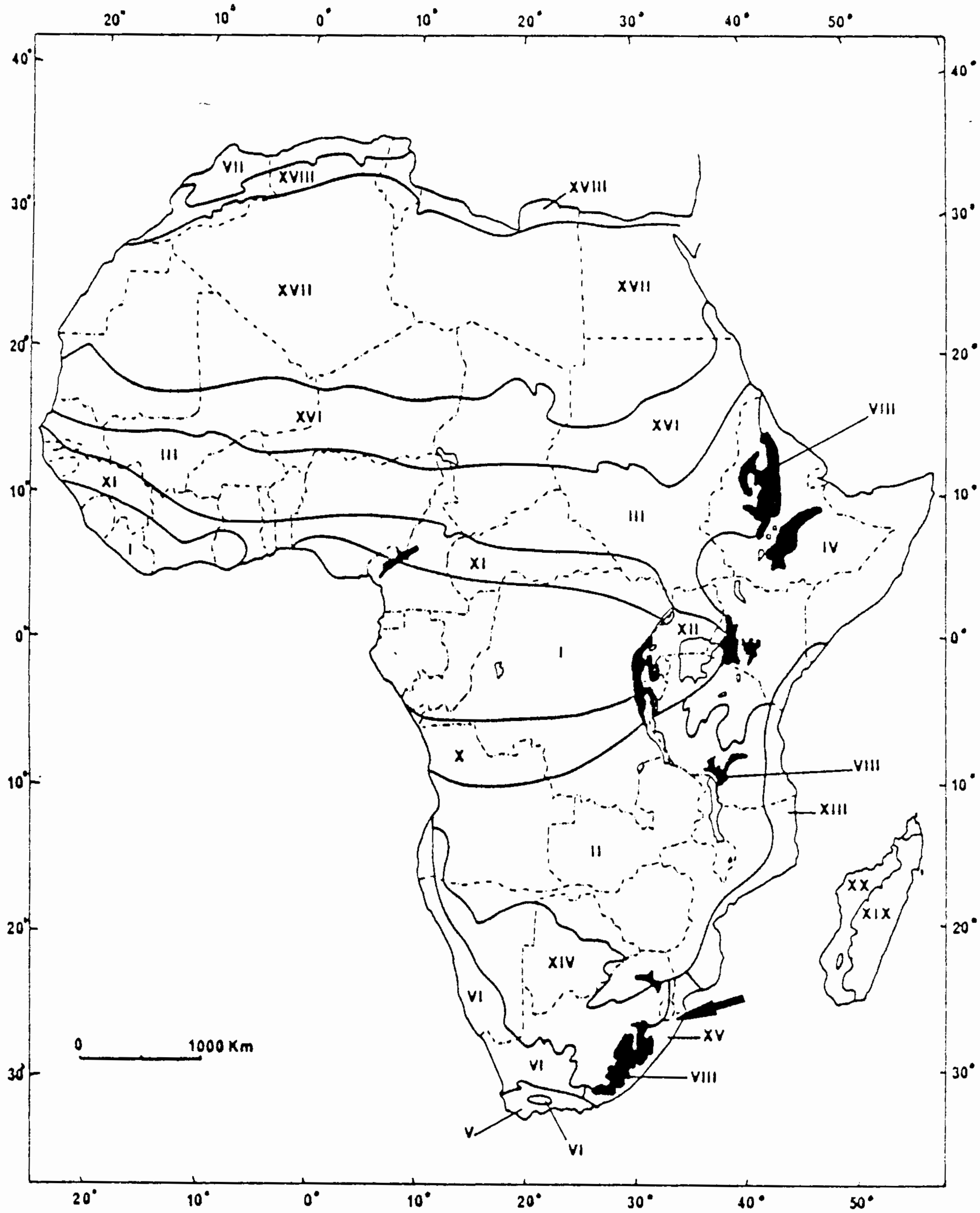


Figure 3. Main phytochoria of Africa and Madagascar (White, 1983).
I. Guineo-Congolian regional centre of endemism. II. Zambezian regional centre of endemism. III. Sudanian regional centre of endemism. IV. Somalia-Masai regional centre of endemism. V. Cape regional centre of endemism. VI. Karoo-Namib regional centre of endemism. VII. Mediterranean regional centre of endemism. VIII. Afromontane archipelago-like regional centre of endemism, including IX, Afroalpine archipelago-like region of extreme floristic impoverishment (not shown separately). X. Guinea-Congolia/Zambezia regional transition zone. XI. Guinea-Congolia/Sudania regional transition zone. XII. Lake Victoria regional mosaic. XIII. Zanzibar-Inhambane regional mosaic. XIV. Kalahari-Highveld regional transition zone. XV. Tongaland-Pondoland regional mosaic. XVI. Sahel regional transition zone. XVII. Sahara regional transition zone. XVIII. Mediterranean/Sahara regional transition zone. XIX. East Malagasy regional centre of endemism. XX. West Malagasy regional centre of endemism. The study area, in the Tongaland-Pondoland regional mosaic (XV) is indicated by the arrow.

Figure 9. Coast Zone. High forested dune system around "half-heart" shaped bay. Main canopy trees are *Mimusops caffra*, *Ziziphus mucronata*, *Apodytes dimidiata*, *Balanites maughamii*, *Croton gratissimus*, *Drypetes natalensis* and *Ptaeroxylon obliquum*. *Acacia karroo* is common on fallow fields and disturbed areas. Note cleared cultivated area at lower right corner.

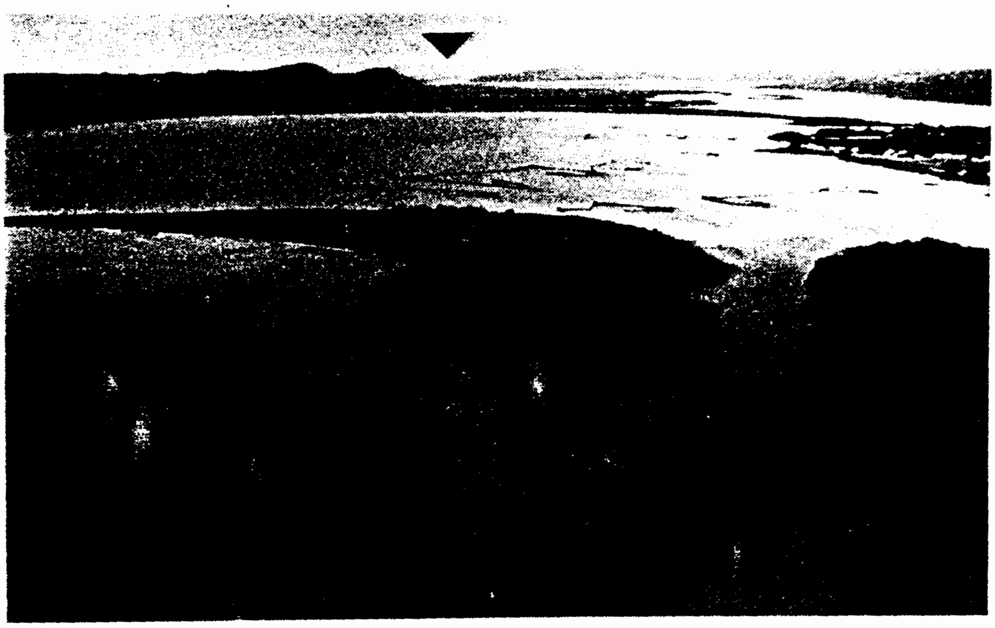


Figure 10. Coastal Lake Zone. View looking northwards of the Kosi Lake System, with the long-shore dune system broken at top centre (arrow) at the estuary mouth. From this point (Enkovukeni) through a series of four lakes connected by channels (see above), salinities gradually decrease towards the freshwater Lake Amanzimnyama in the south. The fish-kraals, seen in the figure are constructed mainly from *Hymenocardia ulmoides* poles cut from the Coastal Forest on the western margin of the lake. The swashbank island at the centre is ringed by a narrow bank of tall *Juncus kraussii* plants suitable for sleeping mats.

Figure 11. Coastal Lake Zone. The mangrove community at the northern end of the Kosi Lake system looking south-east at the Coast Zone dune cordon. Five mangrove species (Bruguiera gymnorrhiza, Avicennia marina, Rhizophora mucronata, Lumnitzera racemosa and Ceriops tagal) are represented.

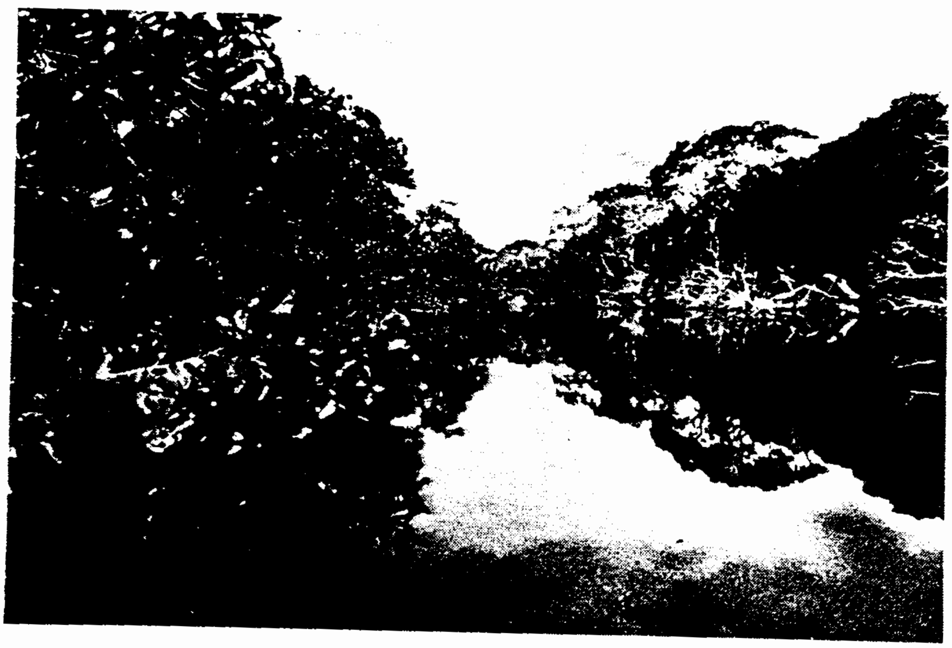


Figure 12. Coastal Lake Zone. The tannin stained freshwater inflow into Lake Amanzimnyama at the southern end of the Kosi Lake System, fringed with Swamp Forest. Syzygium cordatum forms the commonest canopy species, with Ficus trichopoda (at left), Voacanga thouarsii, Myrica serrata, Raphia australis and Rapanea melanophloes also well represented.

Figure 13. Coastal Lake Zone. Coastal grasslands on pale sands comprise a large portion of this zone. Common grass species are Urelyetrum squarrosum, Elyonurus argentius, Themeda triandra, Monocymbium ceresiiforme and Apochaete hispida. Throughout the grass cover are small fruit bearing woody plants, like Parinari curatellifolia, Salacia kraussii and Eugenia capensis subsp. albanensis. These fruit after burning providing the subsistence food that these women are collecting (October 1980).

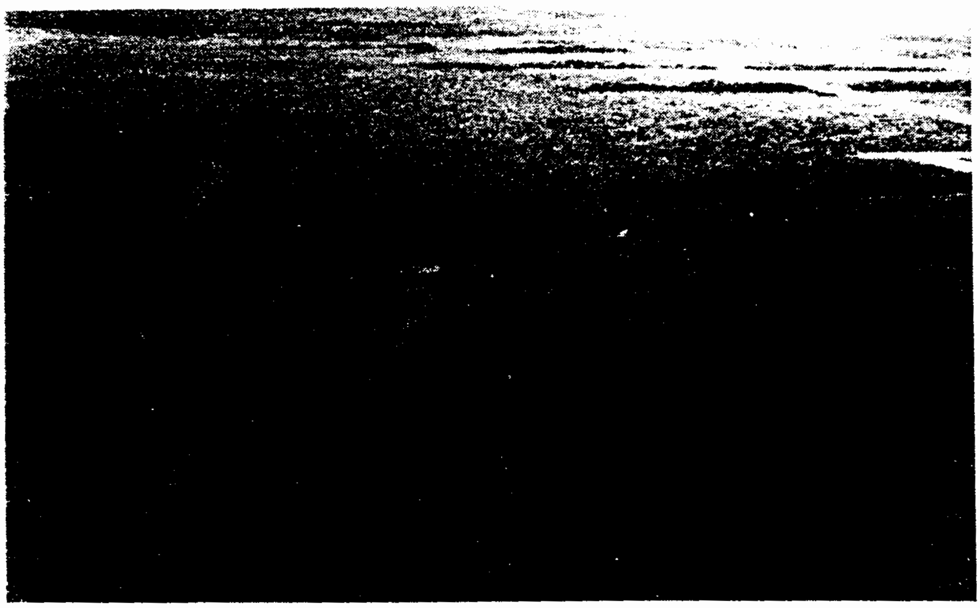


Figure 14. Mosi-Palm Zone. View westwards towards the Sand Forest Zone, showing the Hyphaene natalensis dominated palmveld interspersed with seasonally waterlogged Ischaemum arcuatum - Imperata cylindrica hygrophilous grasslands in depressions and dry Coast Forest on higher lying linear north-south orientated dune ridges with Balanites maughamii, Manilkara discolor, Hymenocardia ulmoides, Dialium schlechteri and Haplocoelom gallense as common canopy species.

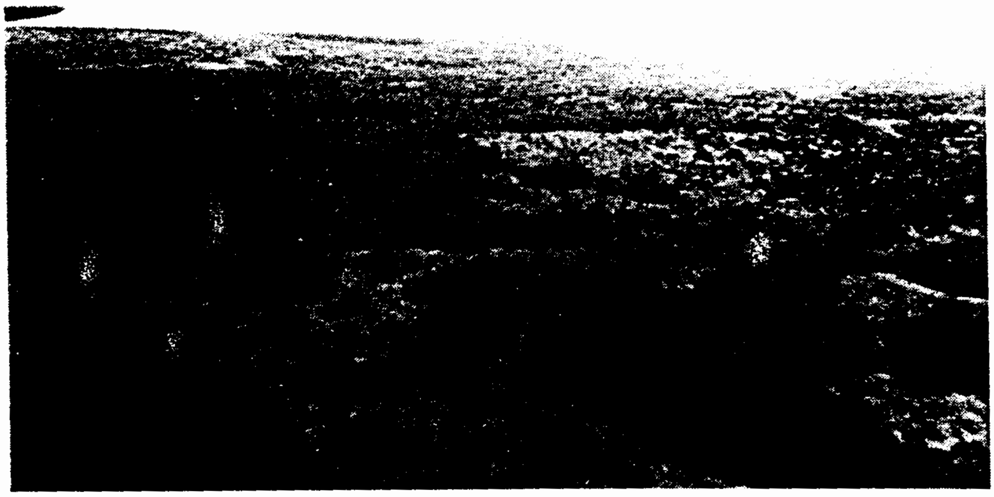


Figure 15. Sand Forest Zone. Darker sand forest and thicket patches on compact fine sands with patches of open woodland in between them. Common canopy trees are *Newtonia hildebrandtii*, *Cleistanthus schlechteri*, *Erythrophleum lasianthum*, *Pteleopsis myrtifolia*, *Hymenocardia ulmoides* and *Manilkara discolor*. In open woodland, *Terminalia sericea*, *Acacia burkei* and *Sclerocarya birrea* predominate, with *Combretum molle*, *Albizia versicolor* and *Albizia adianthifolia* also common.

General descriptions of the vegetation over the entire study area have been given by Moll (1978, 1980) and Tinley and van Riet (1981). Coast Zone vegetation (Figure 8), primarily Dune Forest, has recently been reviewed by Breen (1979) and Weisser (1980). Coastal Lake Zone vegetation (Figures 10, 11, 12, 13) has been described in detail by Tinley (1958a), b), Howard-Williams, 1979, 1980; and reviewed in Begg (1978). Moll (1978, 1980) provides a description of the Mosi-Palm Zone vegetation (Figure 14) while Tinley (1964), De Moor et al (1977) and Pooley (1978) describe the Sand Forest in Ndumu Game Reserve (Figure 15).

HISTORICAL BACKGROUND

The historical background to the area has been summarised by Bruton et al (1980) and more recently in an excellent review by Harries (1983). Detailed information on trade politics in the eighteenth and early nineteenth centuries is available in Hedges (1978). Most relevant to this project is the increasing impact of man on the vegetation. Firstly, with cultural change from hunter-gatherer to agriculturalist/pastoralist and trader with the development of commerce and secondly, the increasing density of people (Table 1, Figure 17) and cattle as small-pox, rinderpest and sleeping sickness were eradicated. Because of the quantity of published information on the historical and political development of the area recently summarised by Bruton et al (1980) and Harries (1983), only

Table 1. The known, estimated and projected rural population of Maputaland from 1900-2000. Note that several of these figures differ from those given by Bruton (1980) and seems likely that some of his data (for example the 1960 and 1970 figures) are incorrect.

YEAR	RURAL POPULATION ** INGWAVUMA	UBOMBO	TOTAL	ESTIMATED OR PROJECTED POPULATION*	SOURCE
1900	23 611	-			Colenbrander (1901)
1901	21 700	10 865	32 565		Colony of Natal (1902)
1902	22 122	12 500	34 622		Colony of Natal (1903)
1903	22 122	12 500	34 622		Colony of Natal (1904)
1904	19 678	12 000	31 678		Colony of Natal (1905)
1905	20 067	14 700	34 767		Colony of Natal (1906)
1906	24 475	12 000	36 475		Colony of Natal (1907)
1907	24 768	12 626	37 394		Colony of Natal (1908)
1908	25 000	14 058	39 058		Colony of Natal (1909)
1909	28 312	16 025	44 337		Colony of Natal (1910)
1910					
1911	25 849	-			Union of South Africa (1911)
.					
.					
1921	26 547	15 721	42 267		Union of South Africa (1927)
.					
.					
1936	39 576	22 413	61 989		Union of South Africa (1937)
.					
.					
1946	40 064	21 705	61 769		Union of South Africa (1946)
.					
.					
1951	47 668	20 075	67 743		Bureau of Census and Statistics (1951)
.					
.					
1960	59 500	26 492	85 992		Bureau of Census and Statistics (1960)
.					
.					
1970	65 398	43 562	108 960	112 544	Department of Statistics (1970)
.					
.					
1975				130 300	
.					
.					
1980	86 307	62 146	148 453	153 300	Bruton, 1980
1985				180 400	
1990				212 200	
1995				244 500	
2000				280 000	

* Thorrington-Smith et al, 1978

** Note: the rural population has been taken as the total Black population of the area, who in 1980 represented 98.6% of the total population of the Maputaland area (Bruton, 1980), and 98.8% of whom were rural and 1.2% urban in 1975 (Thorrington-Smith et al, 1978).

details directly relating to the plant - people interaction are discussed here.

There can be few places in Africa where the plant - people interaction is better put into perspective than Maputaland, for the earliest record of Homo sapiens comes from Border Cave (90 000-110 000 years BP) (Beaumont, et al, 1978, Beaumont, 1980). At this time, higher late Pleistocene sea-levels covered areas that are now the site of intense conflict between conservationists and subsistence agriculturalists. Impact on the vegetation was reduced by the low densities and mobility of these hunter-gatherers. Cultivation was probably not known until the early Iron Age but the indigenous vegetation could still have been manipulated with the use of fire to improve fruit yields and to attract game. Today herd-boys burn patches of the coastal grasslands and palmveld to improve grazing for cattle and the yield of fruit bearing Eugenia capensis subsp. albanensis, Parinari curatellifolia and Salacia kraussii plants and there is increasing evidence that hunter-gatherers in North America and Australia similarly used fire technology as a management tool (Lewis, 1982). However, this burning by hunter-gatherers would have been restricted mainly to areas with high game biomass(clay rich "sweetveld") or in proximity to coastal or lacustrine resources. Iron-Age agriculturists, present on the coastal plain from at least 1 600 BP (Hall and Vogel, 1978), like hunter gatherers in the past, restricted themselves to the coast and Coastal Lake Zones where water, fish and shellfish and better agricultural soils were available. Agriculturalists, (probably growing indigenous crop plants like Eleusine coracana, Coleus esculentus and Plectranthus sp. that are still grown in small quantities in the area) were less mobile and therefore would have had a greater impact on the vegetation. The same concentration of people around the wetland areas can be seen today (Figure 16). I have no doubt that like subsistence agriculturalists in the area today, these people had an excellent idea of the limitations of the local soils within the scope of their available technology. Land-use planning is not a new idea. It has merely become formalised. Neither is commercial exploitation of plant or animal resources a twentieth century innovation in the area.

Until about 1775, the Nguni people in Zululand were divided into small tribes "kept small by constant fission" but between 1806 and 1816 several small kingdoms were established (Gluckman, 1958; quoted in Hedges, 1978). Harries (1983) has pointed out Bryant's (1929) view that Tsonga speakers were pushed northwards by the Zulu and Mthetwa people about 1770, at about the same time as the Ngwane were pushed away from the Delagoa Bay area by the Tembe people who wished to monopolise trade with Europeans at Lourenco Marques. By 1824, however, Tshaka had established political control between Zululand and Delagoa Bay (Harries, 1983) and Mabhudu and Tembe remained subservient to the Zulu, allowing Tshaka and Dingane access to the fort, the trading company and the ships (mainly whalers) at Delagoa

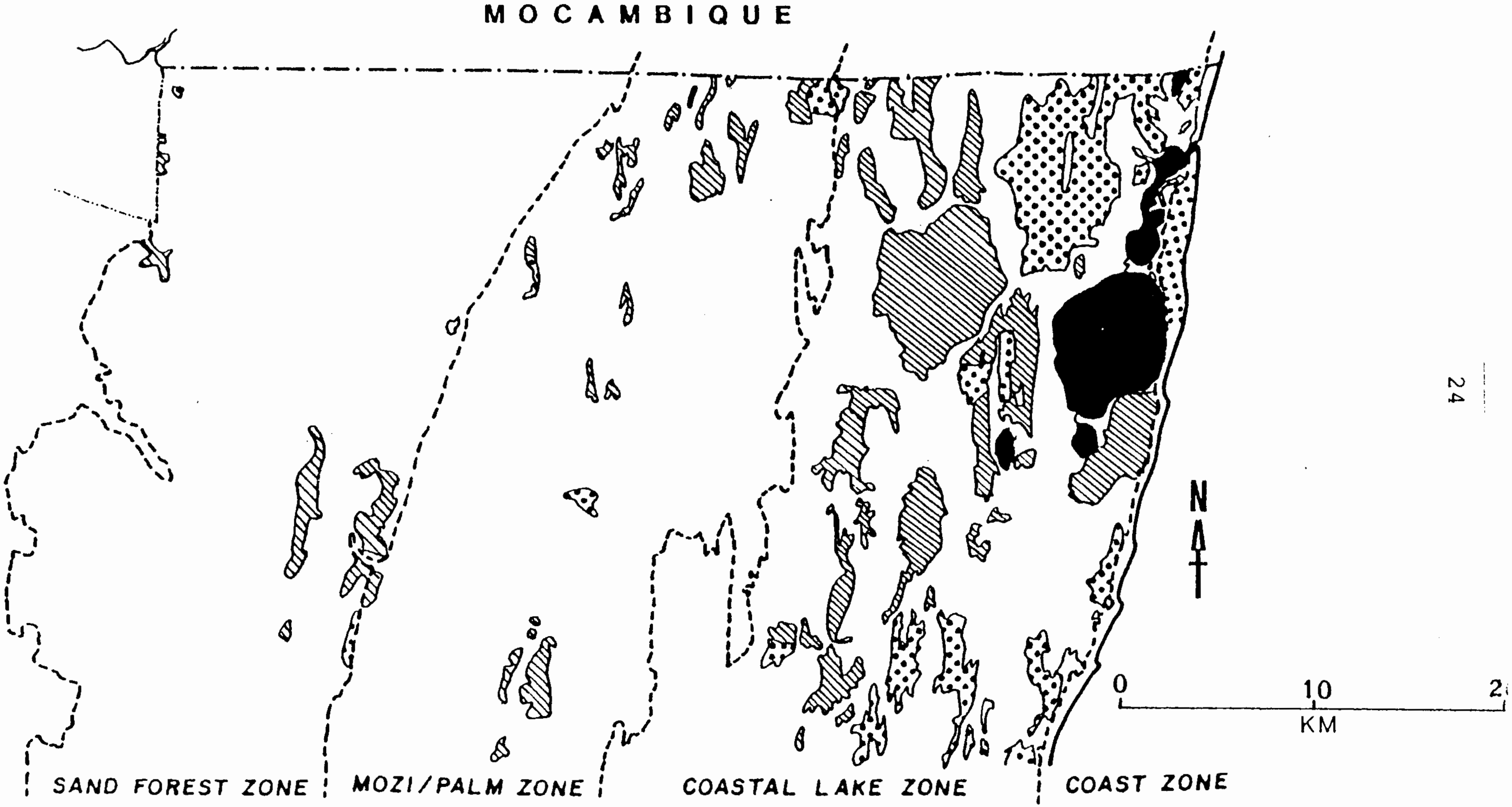


Figure 16. Distribution of cultivated land in the study area (from Loxton et al, 1969) according to ecological zones (from Tinley and van Riet, 1981).
Intensive cultivation [dotted pattern] = more than 40% of the total area cultivated.
Extensive cultivation [hatched pattern] = less than 40% of the total area cultivated.
Only lands showing signs of recent cultivation were included.

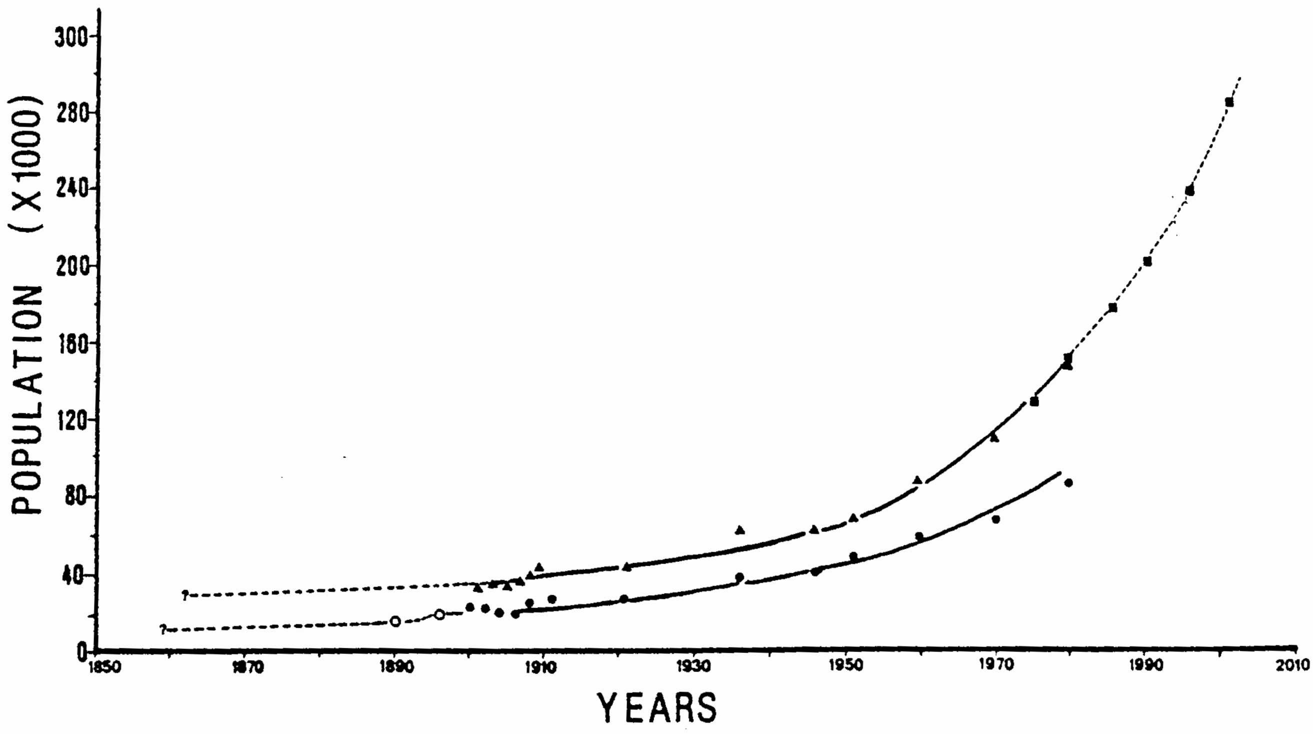


Figure 17: The growth of the population of Maputaland (1900-2000) (upper curve) and the Ingwavuma district (1900-1980) (lower curve). The projected population numbers from 1975-2000 are from Thorrington-Smith et al, 1978. In this case, Maputaland is taken to represent the combined populations of the Ubombo and Ingwavuma districts also referred to by Thorrington-Smith et al (1978) as KwaZulu Area No 1. The open circles in the lower curve represent the hypothetical level of the population before and after Ngwanase and his followers entered "British Maputaland" in 1896.

Bay (Hedges, 1978). Coupled with this political wrangling was the establishment of trade with the Tonga people.

According to James Stuart's informants, "Tshaka began this great commerce with the Tongas, although Dingisayo may have started it... Things were fetched from Tongaland year by year. No year passed without this being done... We would go and demand these things. If people refused we would stab them. They had to pay tribute with these things in Zululand - that is the nearer, small, low country tribes" (Webb and Wright, 1976).

Maputaland, as one of James Stuart's informants said in 1903, "has long been supplying the country for Zululand" (Webb and Wright, 1976). Indigenous plants and the carving and weaving skills of the Thonga people played an important role in this trade. Beer baskets and food baskets made of Hyphaene natalensis, ornamental sticks and knob-sticks were all obtained from this area. By 1834, it was reported that Zululand was glutted with beads brought to Delagoa Bay by whalers and marketed at cheaper rates than those in the British Colony, and in 1824 that the ivory trade with Delagoa Bay was increasing (Hedges, 1978). During the 1840's and 1850's, Zulu influence was restricted mainly to the Tembe and Maputo, who occupied the southern trade route to Lourenco Marquest (Harries, 1983).

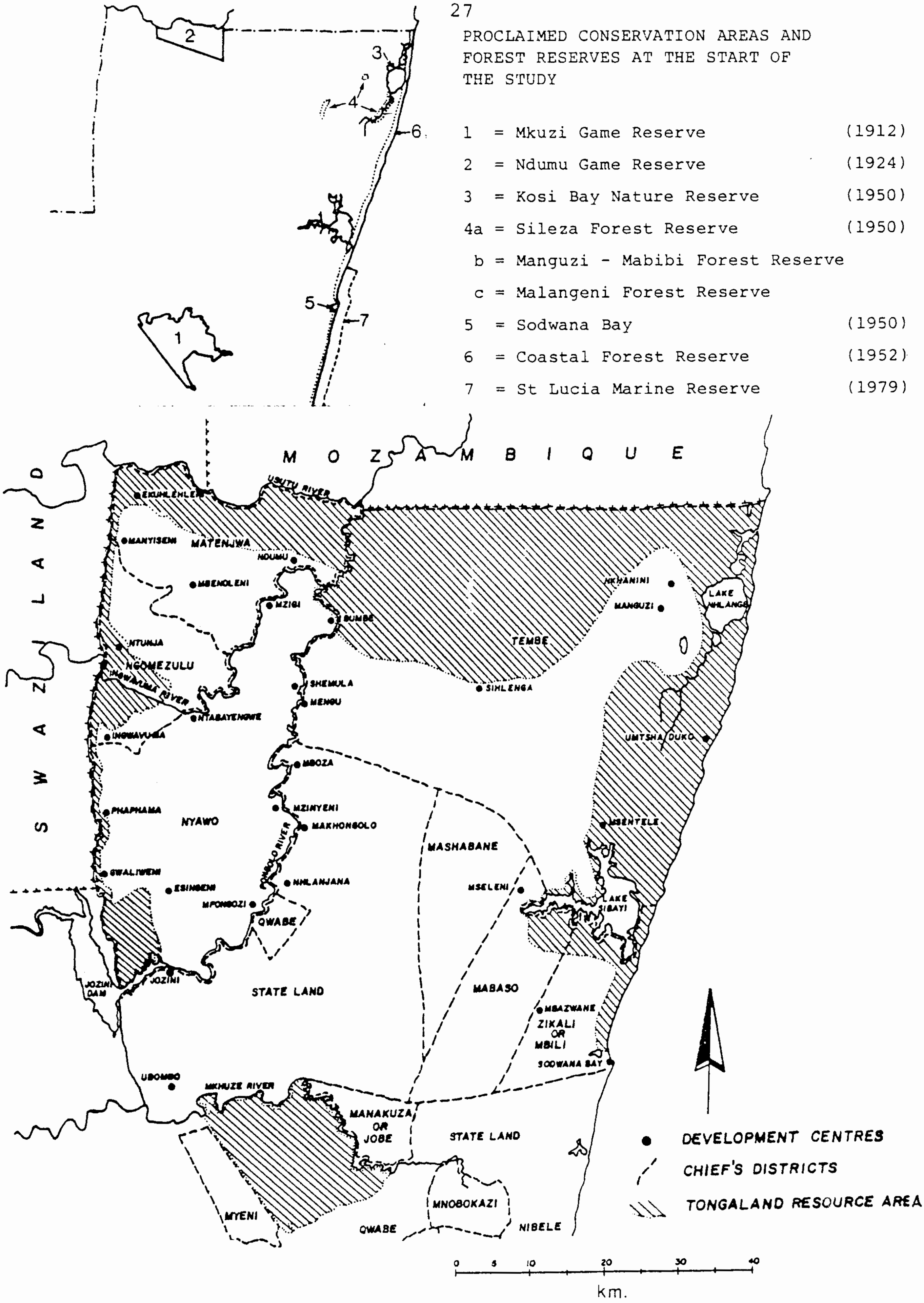


Figure 18. The "Tongaland Resource Area" and development centres proposed by Tinley and van Riet (1981) in relation to chief's districts (from Tinley and van Riet, 1981) and inset, the existing conservation areas at the time of their study.

Despite this trade, commercial use of indigenous plant resources would have little impact on the vegetation as both demand and population numbers were low (Figure 17, Table 1). In 1897, two men from the Ingwavuma district that were interviewed by James Stuart said that apart from a famine lasting three years (called iSileyi because it was so "prolonged") during Mwali's time (ie. prior to 1800) and a second famine which took place in about 1807 (called Ukufa ku ka Mwali), food was always plentiful (Webb and Wright, 1979). Because of the problems of disease and discomfort European traders did not settle on the coastal plain until 1896, although trade products were exchanged for ivory, hides and agricultural produce with Chief Nozingili by Leslie as early as 1871 (von Wissell, undated; Leslie, 1875 in Bruton 1980). By 1900, five retail stores were established in the Ubombo district (Turnbull, 1901). The principle trade done by these stores was "in bartering goods for wild-cat skins, and purchasing cattle therewith in the east and south east of the Province".

Apart from the "endemic political instability" and political fragmentation of the area described by Harries (1983), which continues to influence conservation - plant - people interactions today, I think that the most significant events (and non-events) were in the period 1880-1900, with :

1) The start of migrant labour (c.1880). According to two of James Stuart's informants, "a large number (of men)

began to go off during Noziyingili's reign, which began about 1873... The places chiefly visited were Durban, Pietermaritzburg, Port Elizabeth and Kimberley. Many of those who went to work have not returned but live in the places named" (Webb and Wright, 1989).

2) The recommendation that trade schools be established (in this case in the Ubombo district) "with compulsory attendance for boys up to a certain age" (Hulley, 1899). Despite the fact that Hulley (the Ubombo district magistrate) pointed out that this would benefit, in the end, the whole community, both Europeans and natives alike", this was a non-event (1899).

3) A decrease in infant mortality and death rates due to smallpox vaccinations (1899) and subsequenty controlled treatment of measles, malaria, etc. In that same year, this prevented a spread of a smallpox epidemic from Swaziland to the Ingwavuma district (Colenbrander, 1899, 1901) which had come to Tongaland during Noziyingili's reign from Delagoa Bay (Webb and Wright, 1979; evidence of Mahungane and Nkomuza, 1897).

4) Cattle were introduced to the area by traders and returning migrant labourers. On the basis of oral evidence, James Stuart recorded in 1897: "It will be inferred that there were few or no cattle in Tongaland in the early days".

In the same year (August, 1897) a rinderpest epidemic reduced the number of cattle in the Ingwavuma district (which then excluded the "Maputa district" under Chief Ngwanase) from about 15 000 head to 500 head (300 "salted" and 200 "unsalted" cattle) (Colendrander, 1899; Foxon, 1899). This was followed by a long period of low stocking rate in the Ingwavuma district proper (eg. 1901 (2 500 cattle; 5 000 goats); 1902 (800 cattle; 1 500 goats); 1903 (3 000 cattle; 2 700 goats) 1904 (3 328 cattle; 3 315 goats)) (Colony of Natal; 1901, 1902, 1903, 1904). With veterinary controls, there are now (1983) 94 074 cattle, 12 459 goats and a smaller number of sheep in the Ingwavuma district (stock census, 1983).

It was also during this period that colonial botanists first came to the area to investigate the economic potential of indigenous plants.

In hindsight, formal ethno-botanical study has come a full circle. The main motivation for ethno-botanical study in the nineteenth and early twentieth centuries in Africa was in finding plants of commercial value to colonial governments. The "traditional" knowledge of African people was therefore often a key to the potential value of plant species. When use of these plants was quantified or analyses were done, it was primarily for commercial use by the colonial authorities. Little emphasis was placed on neither the social impact of over exploitation of these plants nor on the value that plant utilization may have as an income generating activity for African people. In some cases, over-exploitation of economically important plants by rural people beat the colonists to the post. In the case of Mondia whitei roots for example, "it was proposed at home [England] to utilize these roots for making a beverage akin to 'ginger beer' but a sufficient supply could not be got, even for an experiment". The reason was that a commercial trade in medicinal roots was already established and Mondia whitei which "was at one time fairly plentiful in the coastal districts" (of Natal) was by 1898 considered to have nearly been exterminated by Zulu people who were eager to collect the roots which "found a ready sale in stores" (Medley Wood and Evans, 1898).

Other indigenous species were also considered for economic exploitation but met with limited success. Samples of Landolphia kirkii and Ficus vogelii were collected at Maputa (now KwaNgwanase) in the study area in 1904 and sent to the Imperial Institute, London for analysis as a possible source of rubber. At this time L.kirkii was already being extensively exploited in Mozambique (Table 2) and the Tongaland Rubber Commission

(1901) had also considered *Mimusops*, *Voacanga thuoarsii*, *Tabernaemontana elegans* and *Maytenus acuminata* as possible sources of rubber (Sim, 1903, 1920). The Tongaland Rubber Corporation Ltd, the AmaTongaland Rubber Corporation Ltd and the Pongolo Rubber Estates Ltd were all formed in about 1906 to exploit *L.kirkii* in Maputaland (von Wissell, undated; Sim, 1920). Between 1910 and 1914, syndicates were also formed to exploit *Euphorbia tirucalli* latex in Natal. Due to "statements circulated both in England and Natal as to the prosperity and splendid prospects of the Tirucalli industry" five companies (The Tirucalli rubber concession, the Impanza Tirucalli Co Ltd, Riet Valley Tirucalli Rubber Syndicate, the Euphorbia Syndicate Ltd and Latex Consolidated Ltd) were formed (Sim, 1920). *Euphorbia* species, including *E.tirucalli* were exploited elsewhere in South Africa and exported to Great Britain in large quantities (Table 3).

The aim was also not to provide local employment for rural peasants, but firstly to build up the British economy and secondly that of the Natal Colony. "The whole subject hangs on the labour supply, its cost, and its method of application; the rubber is there, but can only be profitably exploited if the cost of labour and supervision will allow it to be marketed in fair competition with other rubbers; while the value of Tongaland as a rubber field depends altogether on whether the rubber is cropped methodically, or the vines and trees (will be) rapidly and completely ruined by the adoption of destructive

Table 2. The quantities of rubber exported by (A) the Companhia de Mozambique (1894-1908) and (B) from government territory in Mozambique (1904-1907). About half of this quantity represents rubber from *Landolphia kirkii* and half from *Mascarenhasia elastica*. Quantities and economic values are retained as given by Sim, 1920.

A) COMPANHIA DE MOZAMBIQUE - (Quantities in pounds (lb.))

YEAR	QUANTITY (lb)
1894	43,858.7
1895	27,812.4
1896	60,577.0
1897	21,676.6
1898	48,661.8
1899	148,570.4
1900	82,141.4
1901	182,516.4
1902	134,813.8
1903	133,988.8
1904	199,126.4
1905	214,500.0
1906	186,135.0
1907	95,020.0
1908*	68,200.0

Note: Total, 1,647,598.7 lb., (approx. 735 tons) was worth at 4s. per lb. (its average London value), £329,520, or an average of about £23,000 per annum.

* January to June 1908.

B) GOVERNMENT TERRITORY IN MOZAMBIQUE
(Quantities in kilograms (kg)).

YEAR	QUANTITY (kg)	VALUE (REIS)
1904	298,008	318,292
1905	361,803	277,119
1906	438,371	334,003
1907	308,205	264,498

Table 3. The quantity of *Euphorbia* latex (and probably a small quantity of *Landolphia kirkii* rubber) exported from South African Ports to London from 1910 to 1915 (from Sim, 1920).

SOURCE	ANNUAL QUANTITY EXPORTED (lbs)					
	1910	1911	1912	1913	1914	1915
Cape Town[1]	-	2,407	10,225	26,991		
Port Elizabeth[2]	3,345	169	-	1 670		
Durban[3]	179	14,359	114,974	96,978	41,646	12,551
Port Nolloth[4]	5	9,504	13,920	14,059		
Total in lb.	3,529	26,439	139,119	139,698	41,646	12,551
Value as entered for export	£651	£1,461	£3,998	£3,728	£1,214	£364

NOTE : 1 = Probably *E.dregeana* and the other Western Cape species.

2 = Probably *E.cooperi*, *E.ingens*, *E.similis*, *E.triangularis*, *E.evansii*, *E.grandidens* and *E.tetragona*.

3 = *E.tirucalli*

4 = Mainly *E.dregeana*

methods" (Sim, 1903). Conservation and plant utilization were matters dependent on the economic requirements of the colonial government and not on any conservation or rural development policy.

To enable better control of the Landolphia kirkii resource Sim (1903) proposed that a forest station should be established in the neighbourhood of the Pongolo River "where cultivation of indigenous and exotic rubbers could be tried". It was considered "useless and expensive to rely on local free labour" and Sim (1903) proposed that "either indentured Coolies be used, or that a small convict station be established and convict labour utilised". The costs of this were estimated by Sim (1903) to be:

"Forester, 2 years at £250 per annum	£500
Transport charges to and from his station for himself and 20 Coolies	100
20 Coolies at 10s per month for 2 years	240
Food for the same	300
Inspection and incidental expenses (tools, boxes, etc)	160
Total (for 2 years)	£1,300

Probable Revenue (allowing an average of 2½ lbs of latex, dry, per Coolie per working day):-

13 tons Rubber, at £100 per ton, there (on the London Market)	£1,300"

By 1916, the Landolphia and Euphorbia companies had both gone into voluntary liquidation or compulsory closure (Sim, 1920; McCue, 1926). By this time £750 000 had been sunk into the Tirucalli companies in Natal (Sim, 1920) and the Pongolo Rubber Estates Ltd was floated for £125 000 - but its entire rubber output was worth only £101 (von Wissell, undated). During the 1940's efforts were again made in the study area to produce rubber from Landolphia kirkii (during the Second World War) but again were unsuccessful. Equally unsuccessful or impractical were the proposals to export Raphia australis fibre from the Kosi area (Aitken and Gale, 1921) and exploitation of Hyphaene natalensis leaves on a source of fibre (see Moll, 1972).

Today the focus is back on ethno-botany for the same aim (economic growth), but for a different reason. For example, attention is again being drawn to Euphorbia tirucalli as a source of hydrocarbons for use as a diesel substitute (Gandar, 1983) and to indigenous plants in tropical countries with economic potential (NAS, 1975, 1979; Prescott-Allen and Prescott-Allen, 1982). However the costs and the focus have changed. Ironically these reports now highlight how indigenous plants could contribute to the economies and quality of life of the rural poor in developing countries. What has not changed is the necessity to avoid a waste of manpower and money that could result from over-optimism and misleading reports.

SECTION A

GENERAL PAPER : RURAL PEOPLE AND PLANT RESOURCES

"In a perfect world, pastoralism would never have been undertaken on wild lands without pilot projects and research to establish the limits of carrying capacity. We can forgive the past its mistakes if only for the truth they reveal. But in this present time there is no excuse whatsoever for bringing land under cultivation or pasture without knowing whether such use can be sustained. If it cannot, no argument of expedience can justify the despoilation of an adjusted ecosystem and the creation of a desert for posterity".

Fraser-Darling (1960)

"Beyond a critical point within a finite space, freedom diminishes as numbers increase. This is as true of humans in the finite space of a planetary ecosystem as it is of gas molecules in a sealed flask. The human question is not how many can possibly survive within the system, but what kind of existence is possible for those who do survive. (Pardot Kynes, First Planetologist of Arrakis)."

Herbert (1966)

INDIGENOUS PLANT RESOURCES : A BUFFER AGAINST RURAL POVERTY

A B CUNNINGHAM

INTRODUCTION

Land-use planning is a useful tool, but its value depends entirely on the quality of the information on which the planning is based. While productive areas in Africa with good agricultural soils can be farmed successfully with only slightly modified temperate zone technologies and philosophies (Janzen, 1973), marginal areas must be seen from a different perspective. For example an important multiple-use area supplying basic needs to rural people may appear to be unproductive bushland suitable only for monoculture to an urban orientated land-use planner.

Cases of agricultural development leading to deterioration in the nutritional status of families where ecological information and existing land-use practices have been ignored are widespread (Taylor, 1970, 1974; Dewey, 1979, 1980; Doughty, 1979a, b). Ecologists aware of this problem (eg. Fraser-Darling, 1960; Tinley, 1977, 1979) have stressed the idea of meat production from wildlife as an important contribution to the rural economy in marginal areas in Africa, but until recently few data have been available on the resource value of indigenous plants.

Although plant species used medicinally and for food by rural people are fairly well known (Liengme, 1983a) and recent studies have assessed the effects and extent of wood use in rural areas (Best, 1979; Gandar, 1983; Liengme, 1983), there have been no studies to determine the nutritional, economic and utilitarian value of indigenous plants to rural people within a particular region.

This study attempted to evaluate the resource value of indigenous plants to rural people on the Maputaland coastal plain, a low agricultural potential area in the Ingwavuma district, South Africa. While previous studies in this area have recorded the use of indigenous plants as common dietary supplements (Felgate 1965, 1982 ; Pooley, 1978 and Poultney, 1980), analysed the nutritional value of some fruit species (van der Merwe et al, 1967) and provided a list of some of the species used for other purposes (Pooley, 1980), little more was known of the value of this resource.

This paper discusses the importance of indigenous plants to rural people on the coastal plain in meeting their basic requirements. Availability of these resources provides a buffer against drought, seasonal famine and unemployment. Sale of palm wine, reeds and craft-work provides a source of income to approximately 1 000 people. Fruits (76 species) and spinaches (26 species) provide vitamins deficient in starchy staple foods. Thirty-nine species are commonly used in hut-building, 29 species for fencing and 37 species for firewood. Plants used for craft-work (42 species) also provided household items. Loss of these resources through mismanagement would remove an essential buffer against rural poverty. Maintenance of traditional conservation practices, zoning of resource areas and provision of alternatives to over-exploited resources are necessary to conserve this buffer - but without co-ordinated development, this cannot be achieved.

METHODS AND APPROACH

The study area was decided on because of its low agricultural potential, ecological diversity, and cultural homogeneity. Like other African rural areas, the growing population is undergoing rapid cultural, economic and technical change. These changes often erode traditional and cultural values, and customary use of indigenous vegetation is altered or forgotten. Currently used plant resources may have potential for future development, either to complement conventional tropical crops, or for other uses, and local knowledge of these species needs to be recorded before it is diluted and lost.

Large-scale development has been proposed (and implemented) in some parts of the area. Fencing was also proposed for high conservation priority areas, with possible overlap into vegetation types currently of importance to the local people.

Previous work provided background information on the vegetation (Loxton, et al, 1969; Moll, 1978) and was comparable with the broad-scale planning (Tinley and van Riet, 1981) done after the start of the project. The ecological zones used by Tinley and van Riet (1981) related well to the vegetation zones (Moll, 1978) used initially.

Population, homestead and hut numbers for the study area were determined from the boundaries of the areas used by Department of Health malaria surveillance officers. The boundaries of these areas were mapped out either according to roads/tracks, or on the ground using 1:50 000 aerial photographs, with the aid of the Health Department field officers.

Stock numbers (1983) were determined from counts made at dipping tanks within the study area.

The aims of the study were to:

(i) Record plant species used for hut-building, craftwork, food and drink, fencing, firewood and fish-kraals.

(ii) Evaluate the nutritional, economic and utilitarian value of these species.

(iii) Put forward management proposals to allow a compromise between conservation and the aspirations of the local people through controlled use of certain plant resources within the area.

As a regional study, providing a broad base for future work, coverage was wide and necessitated use of five sensitivity levels in order to collect detailed information only on the most significant issues. I felt that the major issues were firstly, the pressure on economically important indigenous plant resources with the cultural change from a susbistence to a consumer orientated economy and, secondly, the extent of plant utilization that could be allowed inside conservation or resource areas in order to reduce local resentment against conservation with the fencing of high conservation priority areas.

Selection of the species for detailed monitoring was only done after an initial field survey. Detailed monitoring also hinged on obtaining permission from the Tembe Tribal Authority, reducing local suspicion, and on having reliable field assistants. Therefore it was only possible to start a detailed monitoring programme after the project began.

Economically important species ranged between two extremes:- on one hand, low productivity species, or products vulnerable to the over-exploitation (medicinal plants; traditional dyes) and on the other, abundant, productive species more resilient to exploitation, either re-coppicing (eg. _Hyphaene natalensis_ and _Phoenix reclinata_ after palm wine tapping) or due to the type of material utilized (leaves, rather than bark/roots/corms). Coverage at the level of least detail was given to the species with low productivity (ie. those species most vulnerable to overexploitation). Although recorded by Tinley and van Riet (1981) as resources that could be used within resource areas (for example medicinal plants from forest areas), for all practical purposes there was such a small margin for error that they could not be considered for sustainable utilization from field populations, unless part of an eradication programme (eg. in the case of Euclea divinorum encroachment).

Conservation management and/or development efforts should rather concentrate on providing alternatives (eg. chemical dyes) coupled with commercial growth of these species and only species use and selectivity were determined. Detailed study (the level of maximum depth) was limited to those species that were extensively used for economic purposes and had potential for sustainable utilization because of their productivity, abundance or resilience to exploitation.

The five levels of detail were:

1. With the help of knowledgeable local people, Zulu and Thonga names, and botanical names of all useful species within each ecological zone were recorded. Questions about medicinal plants were avoided, firstly, because enquiries would invoke suspicion, and secondly, because

this is a specialized type of utilization by a select group of people (iziNyanga, iZangoma) falling within the minimum sensitivity category, and outside the bounds of this specific study, which concentrated on use by the average rural person.

2. Using the information obtained above, interviews were done by field assistants of either a sample of homesteads in selected areas in the Sand Forest Zone or Coastal Lake Zone defined by Department of Health malaria control boundaries (food and firewood species use), or with people selectively using particular species within various zones (palm wine tappers and craft-workers) or field-sampling (fish-kraals, fencing and hut-building materials). Additional background information during the first phase of the study was also obtained during interviews with 300 craftworkers primarily because of their excellent knowledge of local plant resources.

3. Nutritional values were determined from samples of fruit species and palm wine sent to the National Food Research Institute, Council for Scientific and Industrial Research (CSIR)*. Comparative data on starchy sample foods and spinach species were abstracted from the literature.

4. The extent of use of hut-building materials and firewood was estimated using interview information coupled with

*National Food Reasearch Institute, CSIR
P O Box 395, Pretoria, 0001. S. Africa

quantitative data (eg. time fuelwood head-loads or different that species last, coupled with thatch or fuelwood bundle weights).

Coupled with increases in population (1900-2000) or hut-numbers (1964-1983) these data gave a better perspective on annual utilization rates within the region or within specific ecological zones.

5. Extent of use and value of economically exploited species (craftwork, palm wine and reeds) was determined from craftwork project projection records (4 years data, used with permission of the managers of "Ngezandla Zethu"), and daily monitoring of palm wine (21 months) and reed sales (15 months) within the region.

Leaf production data for the two most economically important craftwork species (*Hyphaene natalensis* and *Juncus kraussii*) were collected in the study area and at St Lucia estuary at the southern end of the Maputaland coastal plain.

Comparative data on intensive exploitation of *Hyphaene* and *Juncus* species were collected from studies of *Hyphaene ventricosa* in Botswana (Cunningham and Milton, in press) and *Juncus kraussii* at St Lucia estuary, Natal (Cunningham and Taylor, in prep).

RESULTS

The results are divided into two main sections:-

1. Locally used resources that are exploited on a subsistence scale within a small radius of the homestead (for housing (Table 2), food (Tables 3 and 4), fuelwood (Table 5), craftwork needs (Table 6) and fish-kraals(Figure 1)).

2. Resources with economic value, occurring within a particular vegetation type, which are exploited by local people for commercial purposes, and transported to supply regional demand for building-material (*Phragmites* reeds: Figures 4 and 5) and palm wine (Figures 2 and 3).

In order to provide the broad overview necessary for this paper, Table 1 gives background information on population, land-use and vegetation. The major species used by people in the different ecological zones are summarised in tables and graphs. Quantitative data has been limited here to the economically important species. Detailed information on extent of use of these species and other locally used resources is discussed in more detail in Sections B-J.

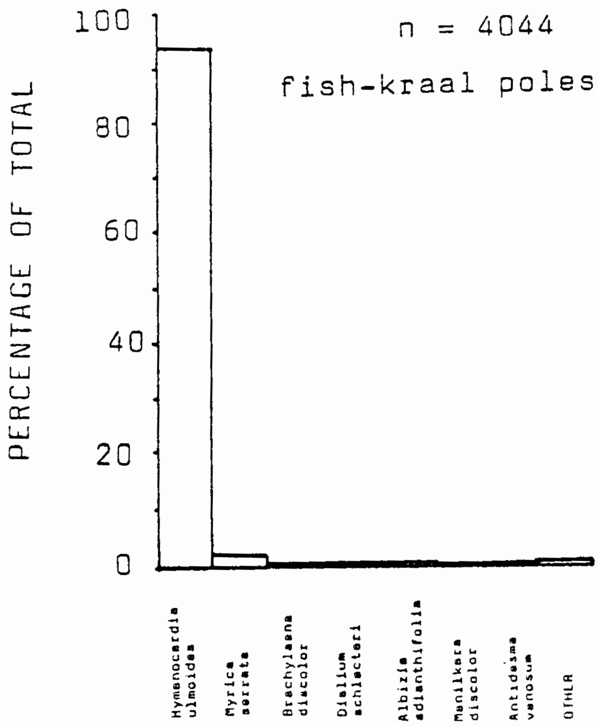


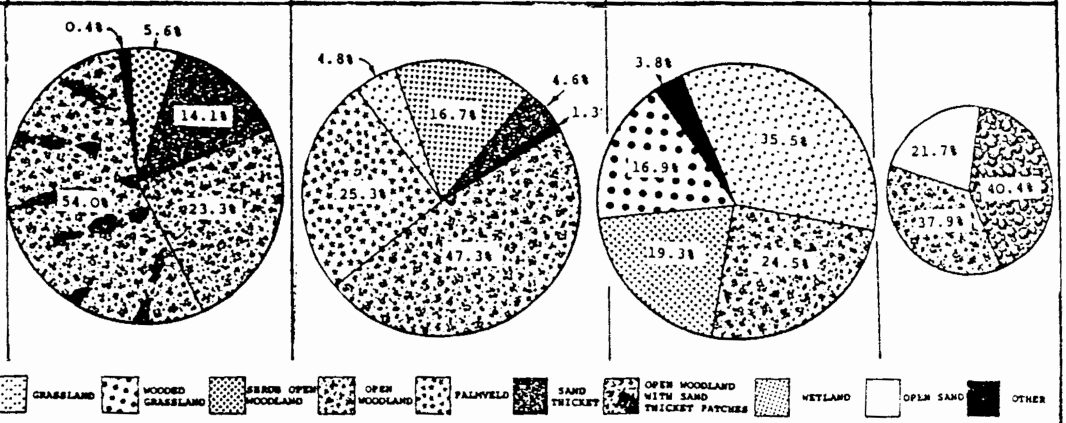
FIGURE 1: Showing selection of hard-wood species for fish kraal construction

TABLE 1: Land-use, population and vegetation cover of the different ecological zones in the study area

ECOLOGICAL ZONE	SAND FOREST	MOSI-PALM	COASTAL LAKE	COAST
AREA (km^2)	642	570	661	24
POPULATION DENSITY (km^{-2})	12,1	12.6	31.2	24.1
POPULATION (2)	7794	7213	20631	580
LANDUSE AGRICULTURE Extensive (1) (<40% of area cultivated)	16.6	23.0	126.6	-
Intensive (>40% of area cultivated.)	1.7	4.4	80.2	7
CATTLE DENSITY (km^{-2})	1.7	21.1	7.7	-
CATTLE (3)	1072	12033	5108	-
GOATS	230	632	284	-
SHEEP	11	7	-	-

VEGETATION

(Vegetation cover expressed as a percentage of zone area.)



ECOLOGICAL ZONE	SAND FOREST	MOSI-PALM	COASTAL LAKE	COAST
MAJOR PLANT RESOURCES USED	HARDWOODS (laths, poles, firewood) MEDICINAL PLANTS (bark, roots) EDIBLE FRUITS IMIFINO	PALM-WINE REEDS (commercial) EDIBLE FRUITS WEAVING MATERIAL (Palmae)	HARDWOODS (poles, laths firewood) EDIBLE FRUITS IMIFINO WEAVING MATERIAL (Cyperaceae, Juncaceae)	HARDWOODS (laths, poles, firewood) MEDICINAL PLANTS (bark, roots) EDIBLE FRUITS

1 = Measured from 1:100 000 map (Loxton et.al., 1969) with a Telectronix Digitizer.

2 = Derived from data for malaria surveillance areas (KwaZulu Department of Health) (1983).

3 = Derived from stock numbers at dipping tanks in the study area (1983).

TABLE 2: Housing. Graphs represent percentage of total number of huts (walls/roofs) where specific materials were used

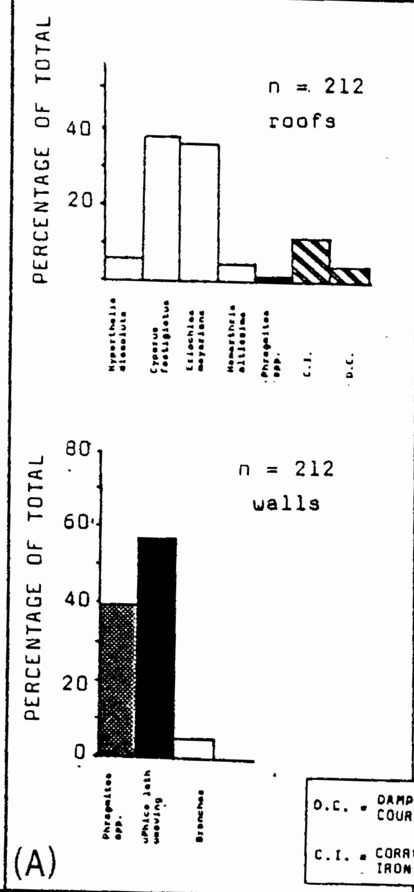
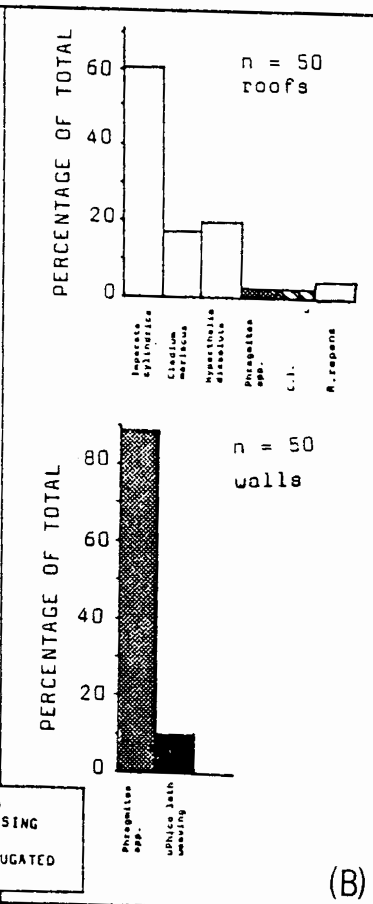
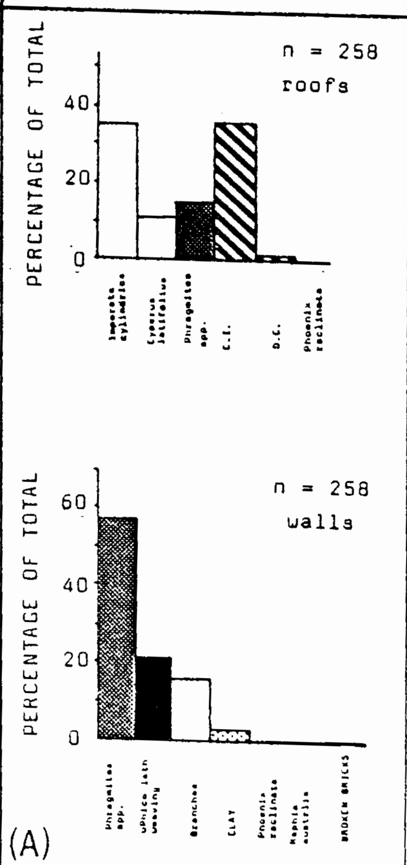
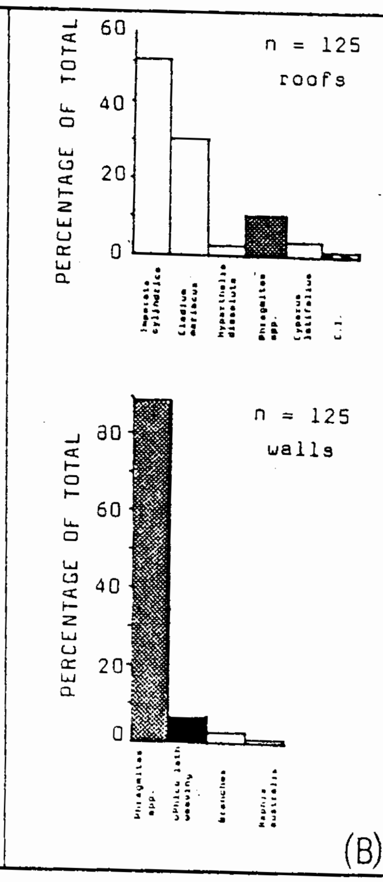
ECOLOGICAL ZONE	HUT BUILDING MATERIAL SELECTION	COMMENTS.
SAND FOREST ZONE	 	SECTION A. SAND FOREST ZONE ADJACENT TO PONGOLO FLOOD-PLAIN. EXTENSIVE AREAS OF *Hymenocardia - Dialium* THICKET ARE THE MAJOR SOURCE OF HARDWOOD LATHS. SECTION B. SAND FOREST ZONE ADJACENT TO MOSI DRAINAGE AREA. EXTENSIVE WETLANDS ARE SOURCES OF *Phragmites* AND *Cladium*. *Imperata* IS COLLECTED IN SEASONALLY FLOODED PANS OF MOSI-PALM ZONE.
MOSI-PALM ZONE	Low population level, restricted mainly to the higher lying area of the adjacent Sand Forest Zone (above). The wetlands of the Mosi Drainage are the source of reeds and thatch for these houses.	
COASTAL LAKE ZONE	 	SECTION A. OPEN WOODLAND, WOODED GRASSLAND AND GRASSLAND OF COASTAL LAKE ZONE. PROXIMITY TO A STORE ENABLES MORE PEOPLE TO BUY CORRUGATED IRON. *Imperata* FROM SEASONALLY FLOODED WETLANDS. *Phragmites* FROM MOSI (COMMERCIAL) OR KOSI SYSTEM. SECTION B. KOSI LAKE AND SURROUNDING WETLANDS. *Imperata* FROM SEASONAL PANS AND DISTURBED FIELDS. *Phragmites* FROM LOCAL WETLANDS.
COAST ZONE	Low population level, apart from the eNkovukeni and Malangeni areas which were included in the sample of huts surrounding the Kosi Lake system and adjacent wetlands (above).	

TABLE 3 : Number and selectivity of edible fruit species in the study are. Graphs represent percentage of the total number of homesteads interviewed where these species are collected

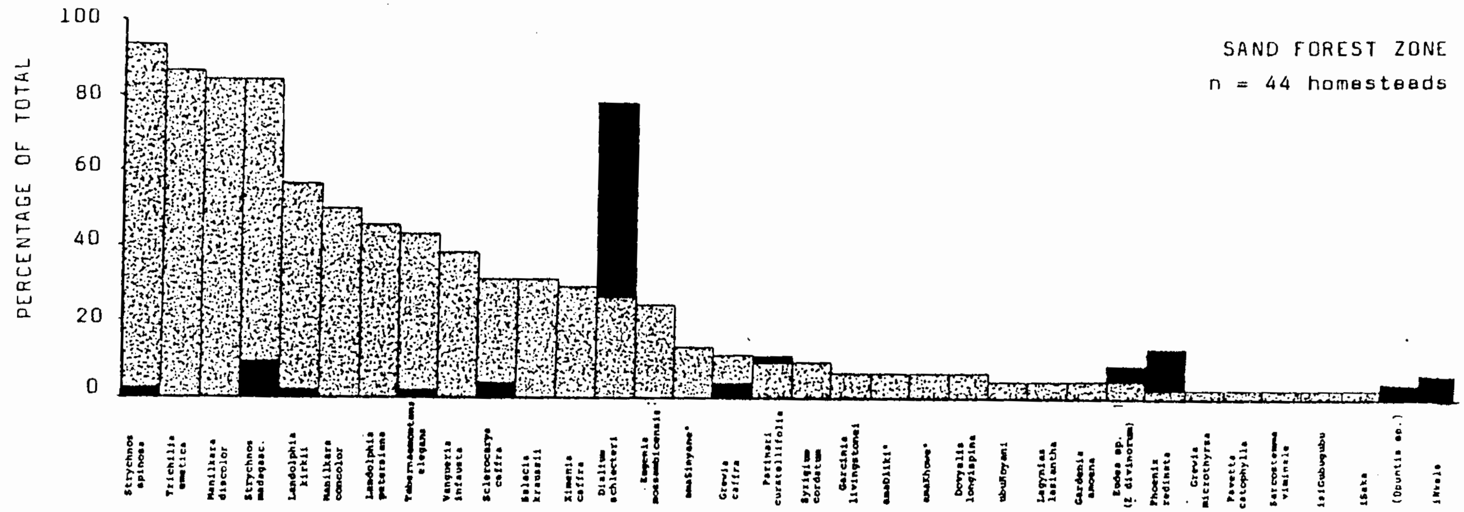
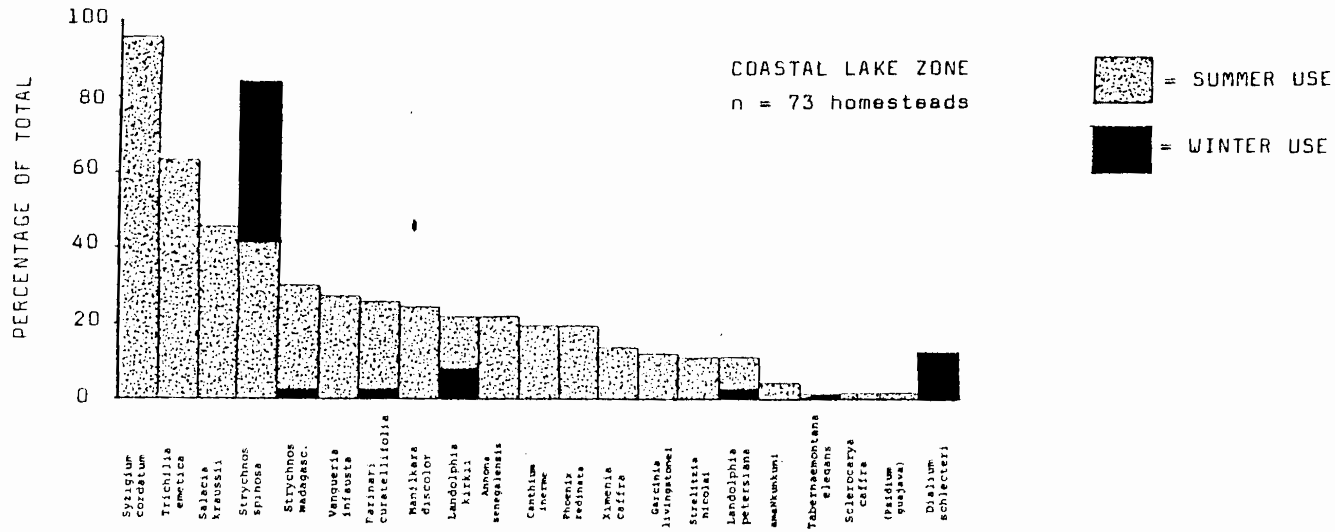
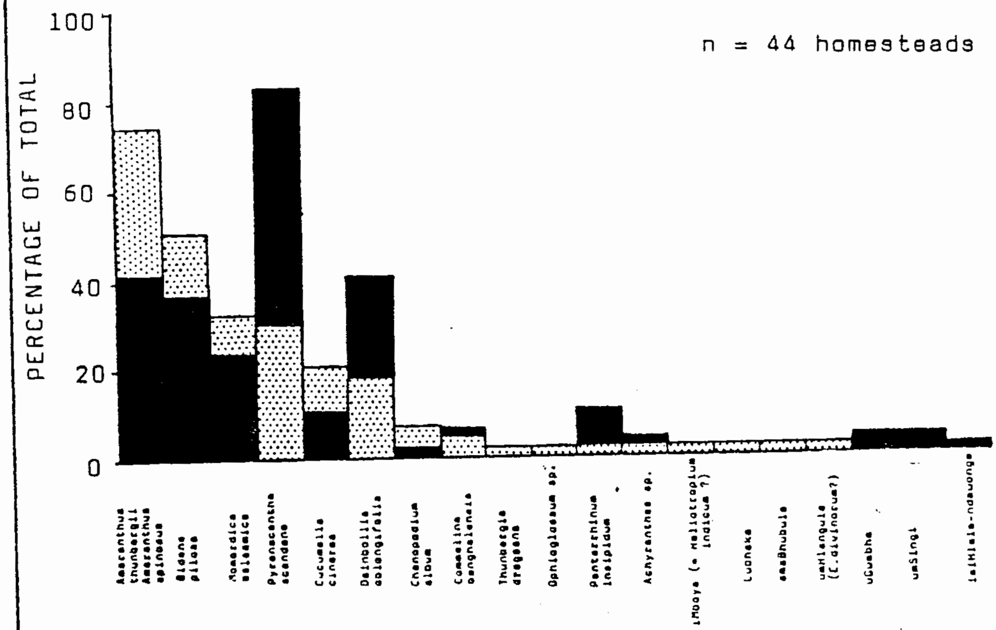
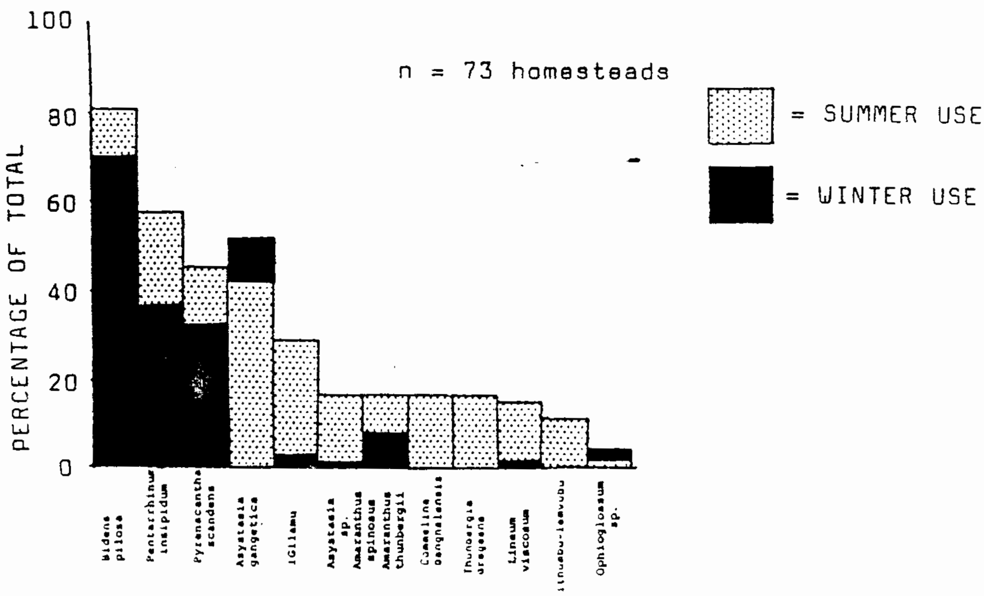
ECOLOGICAL ZONE	FRUIT SPECIES SELECTED	No. edible species available
SAND FOREST ZONE		58 species
MOSI-PALM ZONE	Low population density. Used mainly by herd-boys or during critical periods in the agricultural cycle or during drought (e.g. Collection of <u>Parinari curatellifolia</u> seeds for the kernels (<u>aMongo</u>).	22 species
COASTAL LAKE ZONE		46 species
COAST ZONE	Low population density,apart from eNkovukeni and Malangeni areas.Edible fruit selection concentrated in open woodland (mainly Terminalia-Syzigium open woodland) and similar to Coastal Lake Zone.	45 species

TABLE 4: Number and selectivity of spinach species in the study area. Graphs represent percentage of total number of homesteads interviewed where these species are collected.

<table>
<tr><th>ECOLOGICAL ZONE</th><th>SPINACH (<u>IMIFINO</u>) SPECIES SELECTED</th><th>No. spinach species available*</th></tr>
<tr><td>SAND FOREST ZONE</td><td>


</td><td>20 species (15 + 5 unidentified)</td></tr>
<tr><td>MOSI-PALM ZONE</td><td>Low population level area with only a small portion under subsistence agriculture (Table 1). Cultivated and fallow agricultural fields are the main source of <u>imifino</u>. No data on selectivity available.</td><td>6 species</td></tr>
<tr><td>COASTAL LAKE ZONE</td><td>


</td><td>21 species (19 + 2 unidentified)</td></tr>
<tr><td>COAST ZONE</td><td>Low population level apart from eNkovukeni and Malangeni areas. Spinach species used in these areas the same as those in the Coastal Lake Zone.</td><td>21 species (19 + 2 unidentified)</td></tr>
</table>

* This is likely to be an underestimate.

TABLE 5: Selectivity of species for firewood in the study area. Graphs represent percentage of the total number of homesteads interviewed where these species are collected

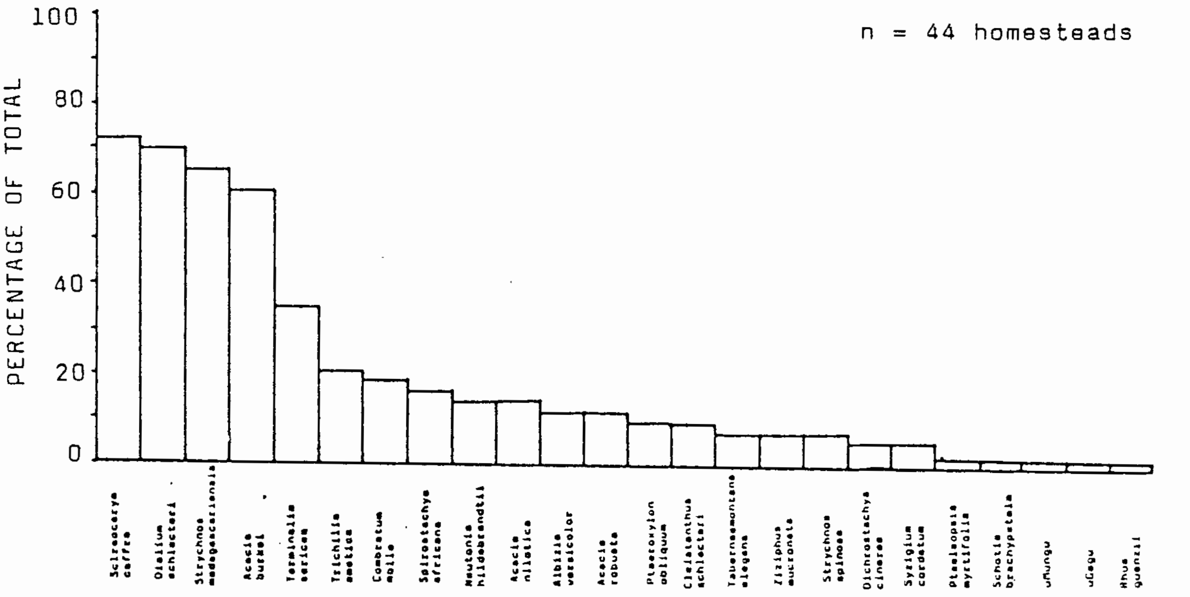
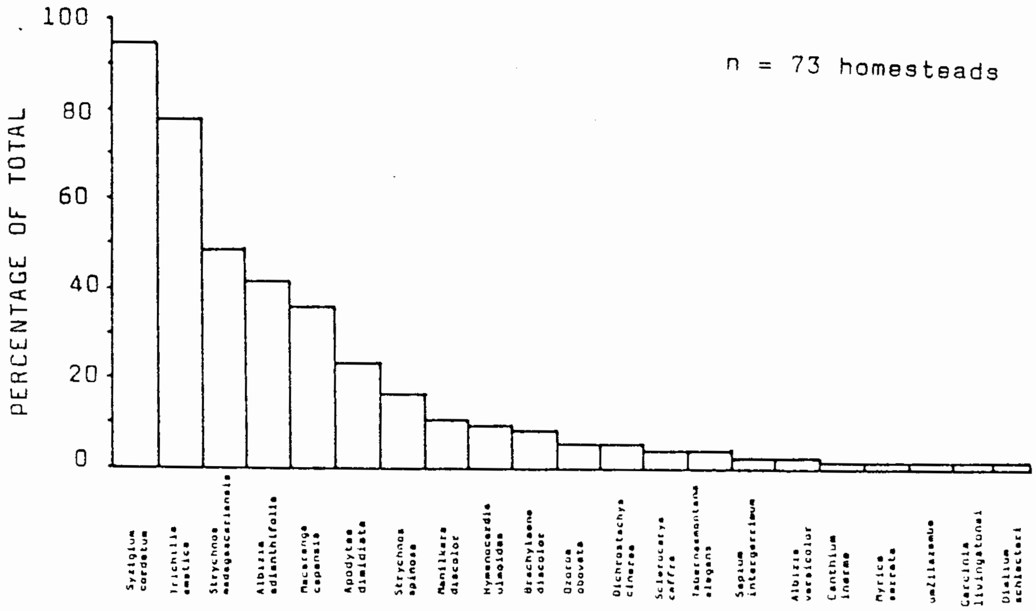
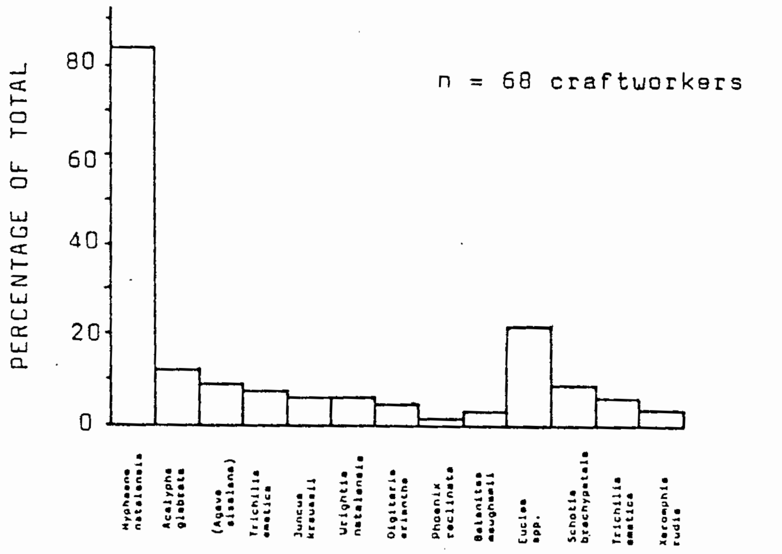
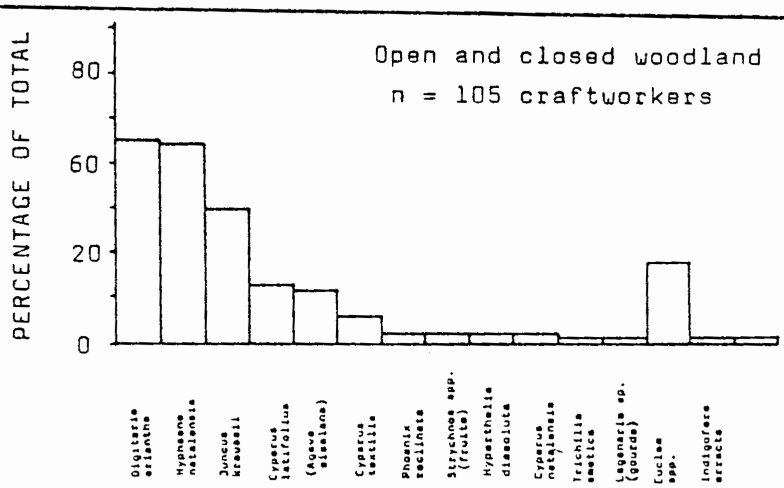
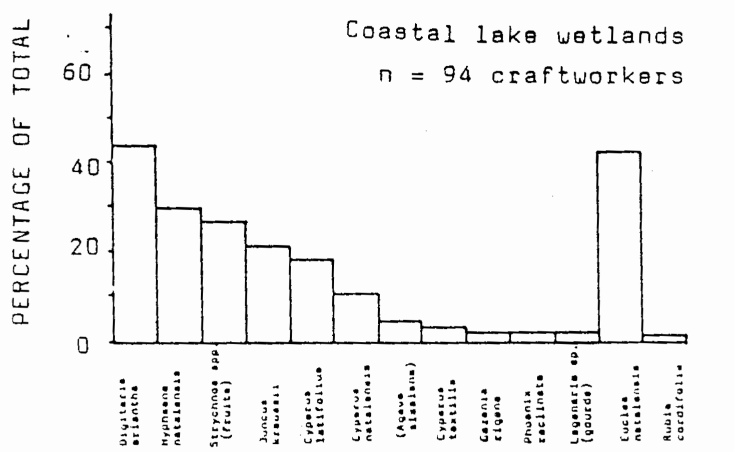
<table>
<tr><th>:OLOGICAL ZONE</th><th>SPECIES SELECTED FOR FIREWOOD</th></tr>
<tr><td>ND FOREST ZONE</td><td>
</td></tr>
<tr><td>MOSI-PALM ZONE</td><td>Low population level area. Main firewood species are <u>Syzigium cordatum</u>, <u>Strychnos madagascariensis</u>, <u>Terminalia sericea</u> and <u>Acacia burkei</u>.</td></tr>
<tr><td>OASTAL LAKE ZONE</td><td>
</td></tr>
<tr><td>COAST ZONE</td><td>Populated areas (eNkovukeni and Malangeni) predominantly <u>Terminalia-Syzigium</u> open woodland or <u>Trichilia</u> coast wooded grassland. Firewood selection similar to Coastal Lake Zone (above).</td></tr>
</table>

TABLE 6: Craftwork. Graphs represent percentage of the total number of craftworkers using these plant species to supply a craftwork project

<table>
<tr><th>ECOLOGICAL ZONE</th><th>SPECIES SELECTED FOR CRAFTWORK</th><th>Craftwork species available</th></tr>
<tr><td>SAND FOREST ZONE</td><td>
</td><td>16 species (wood)
1 species (weaving)
3 species (fruits)
10 species (dyes)

1 species (wood)
5 species (weaving)
7 species (dyes)</td></tr>
<tr><td>MOSI-PALM ZONE</td><td>Major source area for weaving material in the region, but a low population area with few craftworkers.</td><td></td></tr>
<tr><td>COASTAL LAKE ZONE</td><td>


</td><td>10 species (wood)
7 species (weaving)
2 species (bark rope)
3 species (fruits)
7 species (dyes)

10 species (wood)
5 species (weaving)
1 species (bark rope)
3 species (fruits)
7 species (dyes)</td></tr>
<tr><td>COAST ZONE</td><td>The few craftworkers from the eNkovukeni and Malangeni areas were included in the sample of craftworkers from the area immediately surrounding the Kosi Lake and wetland system.</td><td></td></tr>
</table>

REGIONAL RESOURCE A : PALM WINE: 976 630 litres sold during 12 month period (November 1981 - October 1982) generated R157 732 during sale, transport and re-sale

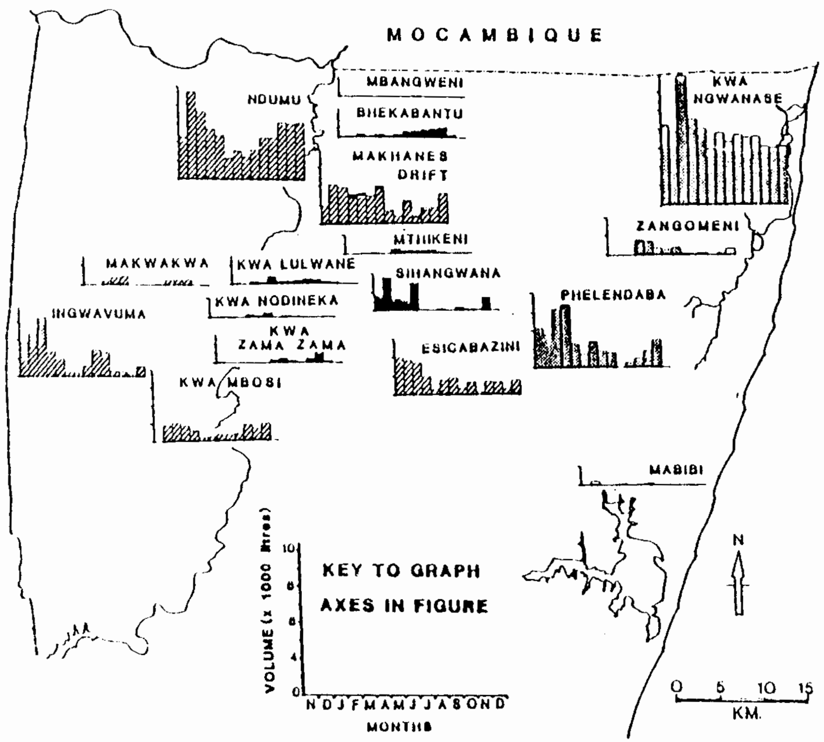


Figure 2. A diagrammatic representation of post-sales distribution over a 14 month period (November 1981 - December 1982) for palm wine from three sale points (Sihangwana, eSicabazini and Phelendaba) in the Maputaland area. Sales from Zangomeni were not included as it was both a sale and a re-sale point, but sales to Zangomeni are shown. Shading denotes source of the palm wine (Sihangwana ■, eSicabazini ▨ and Phelendaba ▥).

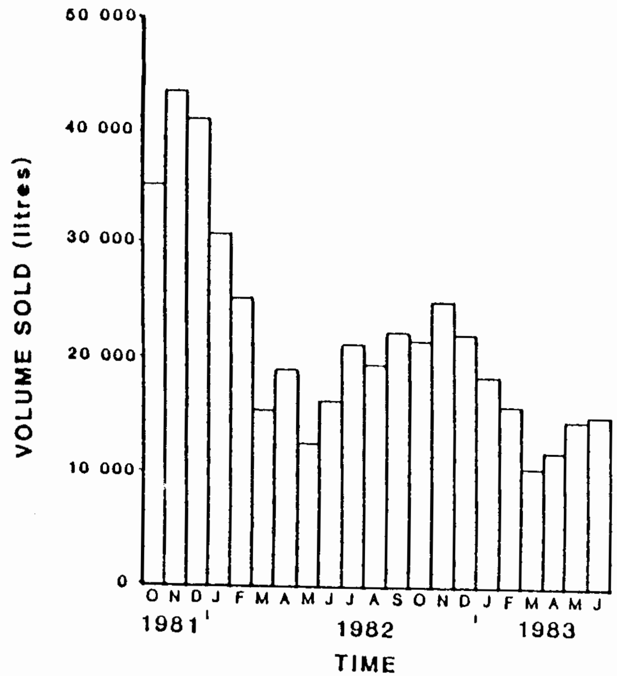
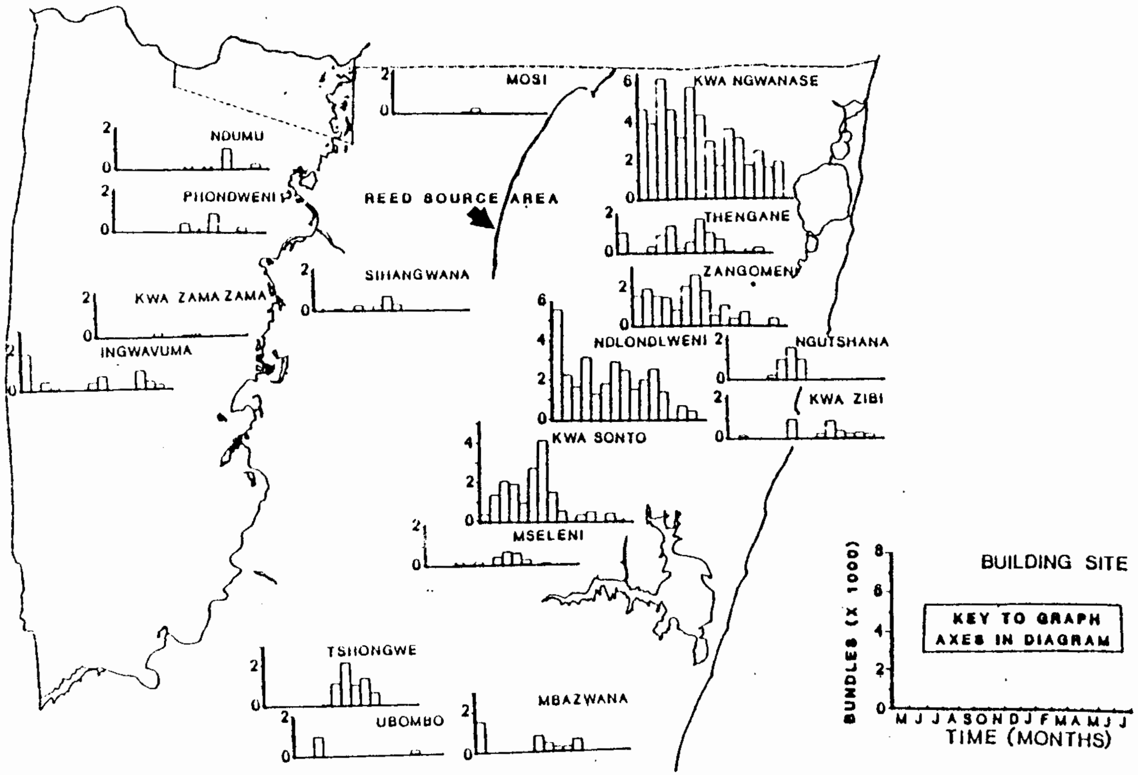


Figure 3. Palm wine sales from eSicabazini over a 21 month period (October 1981 - June 1983) showing sales trends peaking during spring/early summer, followed by a rapid decrease in sales during *Sclerocarya birrea* fruiting time (February - April) when marula beer is brewed throughout the region.

REGIONAL RESOURCE B : REEDS (Phragmites australis) : 19 000 bundles sold (260 ± 60 metric tons) during the 12 month period May 1982 - April 1983 generated R38 000



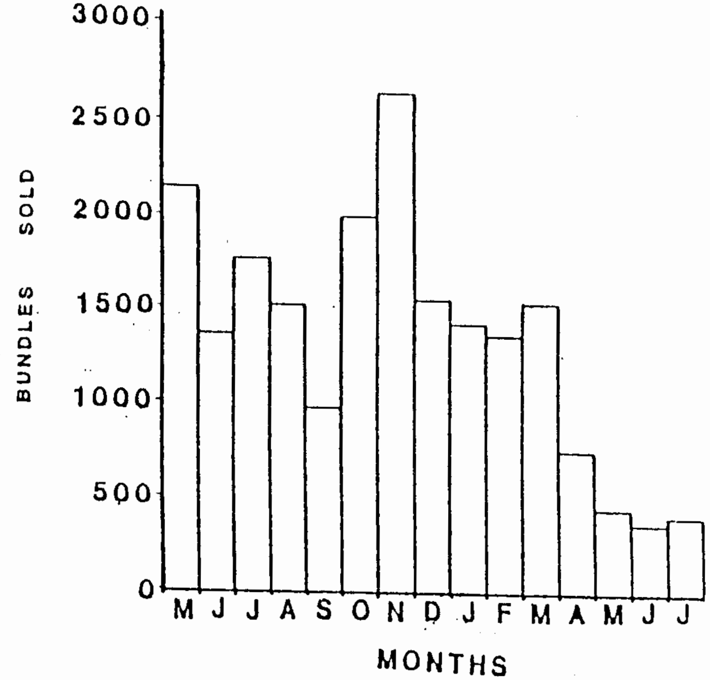


Figure 4 Post-sales distribution of reeds sold from Phelendaba to areas where most building was taking place in Maputaland (May 1982 - July 1983). Regional demand is mainly from the eastern side of the area. Alternative sources of commercially cut reeds at the Tete and Mandlankunzi pans on the Pongolo floodplain are presumably supplying builders on the western side of the Ingwavuma district.

Figure 5 Reed (Phragmites australis) sales from Phelendaba (the only reed sale point in the study area) over a 15 month period (May 1982 - July 1983) showing summer sales peak rainy season when men (hut builders and migrant labourers) return home over the Christmas period.

DISCUSSION

Environmental issues, when held against social problems such as poverty, are often given low priority. Yet any consideration of development in alleviating poverty cannot afford to ignore environmental factors - particularly in Africa, where man and the environment are so closely linked. Food, low-cost housing, fuel and income are issues arising in any discussion of rural poverty. Indigenous plants commonly supply these crucial resources.

It is therfore as important to see poverty in its environmental perspective as in an historical and socio-economic one. The soils of the Maputaland coastal plain have a low water-holding capacity and are highly leached, resulting in poor crop yields and susceptibility to drought. Just as hunter-gatherers (recorded 90 - 100 000 years BP from Border Cave near Ingwavuma (Beaumont et al 1978; Beaumont, 1980) were restricted to high game biomass areas or coastal marine resources, environmental factors affected the settlement of agriculturalists. The Coast and Coastal Lake Zones have permanent sources of freshwater, are close to fish and shellfish resources, while wetlands with higher organic matter (and water holding capacity) provide better soils. These were major determinants of agricultural settlement from at least 1600 BP (Hall and Vogel, 1978) through to the present time, as reflected by the high population densities at present.

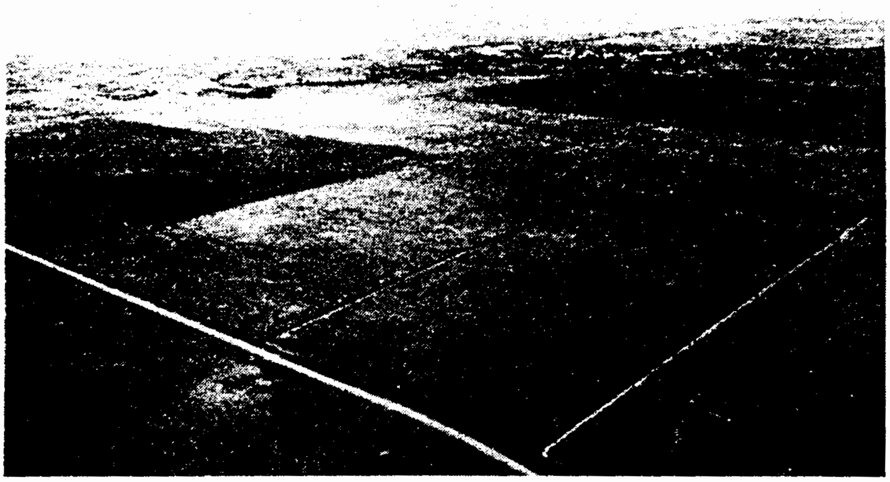


Figure 5: Large scale development (cotton cultivation scheme) in the Pongolo zone near Jozini (Makhatini Flats). Although apparently intended for the settlement of local agriculturalists, none of the Acacia - Dichrostachys - Spirostachys open woodland has been left to provide windbreaks and a source of plant resources (fuelwood, fruits, etc).

Figure 6: The homestead of a subsistence agriculturalist approximately 20 km away from the above site. Note the absence of trees (except those left for fruits and shade) due to firewood collection and agriculture, the use of corrugated iron roofing, the sparse grass cover (ie. limited availability of thatch) and the signs of overstocking (presence of worn paths, absence of grazing).

In the past, man and fire created vegetation diversity, providing a range of vegetation types in various stages of recovery after clearing and burning. This diverse vegetation provided people with a broad resource base with a wide range of plant products available. Sedentary agriculturalists lack the mobility of hunter-gatherers to escape adverse local conditions, increasing dependence and pressure on locally available plant and animal resources. Breakdown of this mosaic and simplification of the vegetation through too frequent burning clearing (Figure 6), or recent large scale agricultural development (Figure 5), both reduce this diversity of choice. While availability of species growing in disturbed communities is increasing (eg. species in fallow fields (spinach (imifino)), thatch grass (particularly Hyperthelia dissoluta and Imperata cylindrica), Digitaria grass species used for craftwork) and fruit species growing in grassland are encouraged by frequent burning and trampling (eg. Salacia kraussii, Eugenia albanensis, Parinari curatellifolia) (Figure 7), low productivity species or areas of climax vegetation are disappearing due to agricultural clearing (Sand Forest, Dry Coastal and Swamp (Hygrophilous) forest) (Figure 8) or commercial exploitation (particularly medicinal plants like Warburgia salutaris, Gardenia thunbergii and bulbous species of Orchidaceae and Liliaceae).

Coupled with this is the rejection of traditional conservation practices as a social stigma develops against the people who

Figure 7: Parinari curatellifolia dwarf shrubs dominating and area frequently disturbed by cattle and vehicles. Note the pale nutrient-poor sands exposed where the vegetation cover has been removed.

Figure 8: Subsistence agricultural plots near the Manguzi-Mabibi Forest (Coastal Lake Zone) in 1980. Prior to 1940 the entire area in the foreground would have been covered by forest. It is now an "anthropogenic open woodland" of fruit bearing or shade giving tree species (eg. Manilkara discolor, Trichilia emetica). The portion of the remaining forest indicated in the background has recently been fenced.

collect indigenous fruits, resulting in loss of knowledge of useful local plant resources (Cunningham, 1982). For rural people living in a low agricultural potential area at a subsistence level, such cultural changes are inappropriate, because they increase the impact of man on the vegetation, reduce the carrying capacity of the area and ultimately the quality of life of the people.

To avoid narrowing of this plant resource base requires ecologically co-ordinated development. From the local perspective all ecological zones are multiple-use areas, use and availability varies between zones and between vegetation types within zones. This is reflected in the use of plants for economic purposes (palm wine, craftwork, building) as well as for housing, firewood, food, fish-kraals and fencing. For example lath woven (uPhico) walls dominate huts in the Sand Forest Zone bordering the Pongolo floodplain. Thatch species covering these huts, cut from wetlands in the Pongolo Zone (Cyperus fastigiatus, Hemarthria altissima and Eriiochloa meyeriana) are not used elsewhere on the coastal plain. Similarly wood and fruit resources from Syzygium cordatum, common on high water-table sands, for example, are only collected by the few people in the Sand Forest Zone who range into the adjacent Mosi-Palm Zone (which also has high water-table sands).

Awareness of the value and extent of plant use puts a new perspective on development options for an area with low potential for agriculture, mining or industry (Loxton et al, 1969; Bruton, 1980).

As Felgate (1965; 1982) pointed out in 1965, the poor quality soils increase local dependence on indigenous plant resources. In the foreseeable future, this will continue to be the case.

Large-scale development can, however, be beneficial, providing employment and income. Revenue from the 6 395 hectare Mbazwane-Mabaso plantation amounts to R80 000 - R90 000 per annum, salaries of over R23 000 are paid out monthly and the tribal authorities receive R4 500 (chief Zikhali), R1 800 (chief Nxumalo) and R11 700 (chief Tembe) annually for the right to use tribal land for afforestation (Bruton, 1980). However, development plans such as afforestation are expensive to implement and maintain and if incorrectly sited could have detrimental socio-economic and ecological effects. Taylor, (1970, 1974); Dewey, (1979, 1980); Doughty, (1979 a, b), all provide examples of the negative effects of development schemes on rural people in Africa and America where social or ecological factors were not taken into consideration. The impact of the cotton scheme on the Makhatini flats, for example, is unknown.

Loxton et al (1969) recommended the Mosi Drainage wetland for rice cultivation and the palm veld for afforestation. On a large scale, this would result in irreversible modifications to the natural vegetation and hydrological regime as well as loss of access to grazing and indigenous plant resources. Hydrological changes resulting from afforestation could also affect vegetation outside the boundaries of the planted area, such as Mfomotini Pan (an elephant drinking area and primary tourist drawcard to the area), put greater grazing pressure on other areas as stock are displaced, and by lowering the water table lower overall plant productivity of the area would result.

During the study period, annual commercial exploitation of indigenous plant resources in the Mosi-Palm Zone of the study area amounted to nearly R210 000 (Table 7) providing income for about 1 000 people.

Table 7: The regional annual economic value and the estimated number of people self employed using indigenous plant material in the study area.

PLANT RESOURCE	ANNUAL VALUE	NUMBER OF PEOPLE GENERATING INCOME	SOURCE
Palm wine	R157 732	460 - 500	Cunningham (in prep a)
Reeds	R 38 000	60 - 80	Cunningham (in prep b)
Craftwork	R 14 109	500	Ngezandla Zethu (unpublished information)
TOTAL	R209 841	1 020 - 1 080	

This table represents economic input from the most economically important species, and must be seen as one aspect of multiple-use land evaluation. Annual income from exploitation of plants of minor economic value (eg. medicinal), nutritional (palm wine), and utilitarian (hut-building, household utensils from palm leaves) values are not taken into account. Mosi Palm Zone is also the major grazing area (Table 1). If only 20% of the 12 000 cattle in the area were sold annually at R300 - R400 per head, this would amount to an additional economic input of between R720 000 - R960 000 per year. These are direct economic values. Other benefits are difficult to ascertain in monetary terms but must also be considered, particlarly scientific and aesthetic benefits (Thibodeau and Ostro, 1981).

Maputaland is rated as having a high tourist potential (Ferrario, 1981) and the open expanse of the palmveld certainly contributes to this aesthetic attraction. The area also has a high species and habitat diversity with a correspondingly high scientific/conservation value (Bruton and Cooper, 1980) and has been suggested as a World Heritage site (African Wildlife, 1983).

This habitat diversity does not only enhance the scientific, aesthetic or conservation value of the area, but also the diversity of resources to the people. Grivetti (1979, 1980) considered that the principal factor contributing to Tswana nutritional success reported by Burgess (1972) at the peak of the drought in the Kalahari was a diversified food base, with an emphasis on indigenous food plants. This view is supported by numerous papers documenting use of these resources during "seasonal famine" (Miracle, 1961), the critical period in the agricultural cycle when there is a lack of other food sources (Hunter, 1967; Fleuret and Fleuret, 1980; Pagezy, 1982) and the ascorbic acid, nicotinic acid, vitamin B and riboflavin content of spinaches (imifino) (Santos-Oliviera and Carvalho, 1975; Hennessy and Lewis, 1971; Lewis et al, 1968; Imbamba, 1973) fruits, palm wine and Sclerocarya birrea beer (van der Merwe et al, 1967; Nash and Bornmann, 1973; Cunningham, in prep c; Cunningham and Wehmeyer, in prep) used in the area these provide dietary nutrients deficient in starchy staple foods.

This does not only apply to food resources, but also applies to indigenous plant resources supplying other needs. Reeds, thatch and wood provide low cost building materials suitable for African conditions (Knuffel, 1973). Collection and transport of these provides local employment and income (Phragmites australis sales during a 15 month period amounted to about R40 000 (Cunningham, in prep b))and preserve traditional skills (van Voorthuizen and Odell, 1976). Loss of these resources means loss of these advantages and poor housing, or at best, expensive alternatives such as corrugated iron and concrete block. Similarly, purchase of firewood has become necessary in widespread areas in Africa (Digenes, 1977; White, 1979; Hall, 1980), taking a quarter or more of total income (Hall, 1980).

Recent tarring of the Ingwavuma-KwaNgwanase-Jozini road has resulted in access to markets for economically important species throughout the region from areas where they are unavailable, catalysing the pressure on these resources. Even productive and/or abundant species such as Phragmites australis (productive and abundant), Hyphaene natalensis (abundant) and Juncus kraussii (productive) that are resilient to leaf or stem harvesting can be over-exploited, with consequent loss of employment and income.

Stand-height and total area of Phragmites australis communities on the Pongolo flood plain have been reduced through cutting, burning, cattle grazing and trampling. In Ndumu Game Reserve, stands protected from fire and cutting are 3-4 metres tall. Along the flood plain outside the reserve, where growth is adversely affected by man and cattle, stand height is reduced to 0.3 - 0.45 metres (Furness and Breen, 1980). Overexploitation of Hyphaene palm leaves has undermined the resource base of craftwork projects in Tanzania (Fleuret, 1980), the Sudan (Babiker, 1982) and Botswana (Cunningham and Milton, in prep). Excessive cutting pressure and poor cutting techniques are similarly contributing factors reducing the quality of Juncus kraussii at the St Lucia estuary

(Cunningham and Taylor, in prep) although the major threat to the *Juncus kraussii* community has been hydrological disturbance resulting from dredging.

The longer the solutions take, the more complex their implementation will become. The average rate of population increase in the area is 2.67% per annum, with an estimated population density of 44.4 people km^2 by 2000, compared to an average figure of 24.3 people km^2 for the Maputaland area in 1980 (Thorrington-Smith et al, 1978; Bruton, 1980). The population density for the coastal Lake Zone already exceeds this (see Table 1). Bruton (1980), and Tinley and van Riet (1981) have both put forward land-use proposals based on ecological principles. Local needs for plant resources have been taken into account in "resource areas" similar in concept to the "managed multiple-use areas" of the IUCN (1978, 1980), with an emphasis on appropriate technology and sustained-use of natural resources and conservation integrated with tourist development. This study has provided quantitative information on plant resource values on the coastal plain, and a higher level of resolution for planning, policy making, and management.

In an ideal world, the ecological guidelines outlined by the IUCN (1980) would be the determinants of land-use. However, while such planning is easy, implementation is not possible in one part of the country while it is not acceptable nationally. The basic problem is that the benefits of exceeding sustainable yield are greater than the long-term costs. Local people in the Maputaland area cannot be expected to bear all the sacrifices necessary to ensure this. Alternatives have to be provided, (for example - woodlots and pole depots, as is currently being done by the KwaZulu Department of Forestry) or adequate compensation given to the community in the case of habitat set aside for preservation by government organizations which have the financial resources. At the present time when 33% of South Africa's 25 million people occupy 12% of the land area (Wildlife Society, 1980) the ultimate solutions lie in the hands of political decision-makers. Only time will tell whether these resources remain as a buffer to rural poverty or whether the IUCN's proposals are a Utopian dream.

CONCLUSION

Land-use options on the Maputaland coastal plain are reduced by environmental constraints and remoteness of the area. Indigenous plant resources are one of the major assets, contributing to the basic needs of the areas people and to the viability of conservation/tourism combined as a land-use option.

Reduction of this plant resource base, either through mismanagement or insensitive development would ultimately be detrimental to the people and to the environment, removing a buffer against rural poverty. Resource management and controlled utilization of plants is necessary, but is impossible to implement without a co-ordinated approach to the intertwined social, economic and political problems.

REFERENCES

AFRICAN WILDLIFE (1983) Editorial. The Ingwavuma Debate 36 4/5:127.

BABIKER, A A (1982) The role of rural industries in the arid and semi-arid areas of the Sudan. Geojournal 6 (1):49-55.

BEAUMONT, P B (1980) On the age of Border Cave hominids 1-5. Palaeont afr 23:21-23.

BEAUMONT, P B, DE VILLIERS, H, AND VOGEL, J C (1978) Modern man in sub-Sahara Africa prior to 49000 BP: A review and evaluation with particular reference to Border Cave. S Afr J Sci 74:409-419.

BEST, M G (1979) The consumption of energy for domestic use in three African villages. MSc thesis, University of Cape Town.

BRUTON, M N (1980) Conservation and Development in Maputaland. pp. 497-529 in Studies on the Ecology of Maputaland. M N Bruton and K H Cooper (eds) Cape and Transvaal Printers, Cape Town.

BRUTON, M N and COOPER, K H (1980) Studies on the Ecology of Maputaland. Cape and Transvaal Printers, Cape Town.

BURGESS, H J L (1972) Nutrition Survey in Botswana, June - July 1971. AFR/NUT/52, Dated 30 May, 1972. WHO Regional Office for Africa. Quoted by Grivetti (1980).

CUNNINGHAM, A B (1982) Making the most of Maputaland's plants. African Wildlife 36 (4/5):190-191.

(in prep a) Palm wine tapping in Maputaland, South Africa I : Contribution to the regional rural economy.

(in prep b) Commercial harvesting of Phragmites australis reeds in a low agricultural potential area.

(in prep c) Use and dietary importance of edible indigenous plants in Maputaland, South Africa.

CUNNINGHAM, A B, and MILTON, S J (in prep). Effects of the basket weaving industry on the mokola palm (Hyphaene ventricosa (Kirk) Furtado) and on dye plants in N W Botswana.

CUNNINGHAM, A B and TAYLOR, R H (in prep) Utilization of Juncus kraussii Hochst at St Lucia estuary, Natal.

CUNNINGHAM, A B and WEHMEYER, A S (in prep) The nutritional value of Hyphaene natalensis and Phoenix reclinata palm wine.

DEWEY, K G (1979) Agricultural development, diet and nutrition - Ecology of Food and Nutrition. B:265-273.

DEWEY, K G (1980) The impact of agricultural development on child nutrition in Tabasco, Mexico. Medical Anthropology 4:21-54.

DIGERNESS, T H (1979) Fuelwood crisis causing unfortunate land-use and the other way around. Nash Geogr Tidskr 33:23-32.

DOUGHTY, J (1979a) The dangers of reducing the range of food choices in developing countries. Ecology of Food and Nutrition 8:275-283.

(1979b) Decreasing variety of plant foods in developing countries. Qualitas Plantarum. 29:163-177. Quoted by Grivetti (1980).

FELGATE, W S (1965) An ecological study of the TembeThonga people. Unpublished report on research work edited by E J Krige 167 pp.

(1982) The Tembe-Thonga of Natal and Mozambique : an ecological approach. Department of African Studies, University of Natal Occasional Publications, No 1.

FERRARIO, F F (1981) An evaluation of the tourist potential of KwaZulu and Natal. KwaZulu Development Corporation, Durban.

FLEURET, A (1980) Non-food uses of plants in Usambara. Econ Bot 34 (4):320-333.

FLEURET, P and FLEURET, A (1980) Nutrition, Consumption and Agricultural Change. Human Organisation 39 (3):250-260.

FRASER-DARLING, F (1960) Wildlife husbandry in Africa. Sci American 203 (5):123-134.

FURNESS, H D and BREEN, C M (1980) The vegetation of seasonally flooded areas of the Pongolo river flood plain. Bothalia 13:217-231.

GANDAR, M V (1983) Wood as a source of fuel in South Africa, Monograph No 4. Institute of Natural Resources, University of Natal, Pietermaritzburg, South Africa.

GRIVETTI, L E (1979) Kalahari Agro-Pastoral-Hunter-Gatherers. The Tswana Example. Ecology of Food and Nutrition. 7:235-256.

GRIVETTI, L E (1980) Agricultural development: present and potential rôle of edible wild plants. Part 2. Sub-Saharan Africa. Unpublished report to USAID. 142 pp.

HALL, D O (1980) Regional development assisted through local renewable energy sources. Presented at the International Conference on "Natural Resources and Regional development the semi-arid regions case". Cocoyoc, Mexico, Oct 1980.

HALL, Mand VOGEL, J C (1978) Enkwazini : Fourth century Iron Age site on the Zululand coast. S Afr J Sci 74:70-71.

Hedges, 1978.

HENNESSEY, E F and LEWIS, O A M (1971) Anti-Pellagragenic properties of wild plants used as dietary supplements in Natal. Plant foods for human nutrition. 2:75-78.

Herbert, 1966.

HUNTER, J M (1967) Seasonal hunger in a part of the West African Savanna. A Survey of Body Weights in Nangodi, North - East Ghana. Transactions, Institute of British Geographers. 41:147-185.

IMBAMBA, S K (1973) Leaf protein content of some Kenya vegetables. East African Agriculture and Forestry Journal 38:246251.

IUCN (1978) Categories, objectives and criteria for protected areas. A final report prepared by the Commission on Criteria and Nomenclature Commission on National Parks and Protected Areas. August 1978. International Union for Conservation of Nature and Natural Resources, Morges, Switzerland, 26 pp.

IUCN (1980) World Conservation Strategy. IUCN. Morges, Switzerland.

JANZEN, D H (1973) Tropical Agro-ecosystems. Science 182:1212-1219.

KNUFFEL, W E (1973) The construction of the Bantu Grass Hut. Graz Akademische Druk. 85 pp.

LEWIS, O A M, SHANLEY, B M G and HENNESSY, E F (1971) The leaf protein nutritional value of four wild plants used as dietary supplements by the Zulu. pp 95-102 in "Proteins and Food Supply in the Republic of South Africa". Papers read at an International Symposium held under the auspices of the University of the Orange Free State in collaboration with the CSIR and Department of Agricultural Technical Services, Bloemfontein, 8-11 April 1968 edited by Claasens, J W and Potgieter, H G. A A Balkema, Cape Town.

LIENGME, C A (1983) A study of wood use for fuel and building in an area of Gazankulu. Bothalia 14 (2):245.257.

(1983a) A survey of ethno-botanical research in Southern Africa. Bothalia 14 (3/4):621-629.

(1983b) Plants used by the Tsonga people of Gazankulu. Bothalia 13 (3/4):501-518.

LOXTON, HUNTING AND ASSOCIATES (1969) Development Plan for Maputaland. Unpublished Map series.

MIRACLE, M P (1961) Seasonal hunger. A vague concept and an unexplored problem. Bulletin de l'IFAN. XXIII, serié B, 1-2, 273-283. Quoted by Pagezy (1982).

MOLL, E J (1978) The vegetation of Maputaland - preliminary report of the plant communities and their present and future status. Trees in South Africa. 29:31-58.

NASH, L J and BORNMANN, C H (1973) Constituents of Ilala Wine S Afr J Sci. 69:89-90.

PAGEZY, H (1982) Seasonal hunger, as experienced by the Oto and the Twa of a Ntomba village in the Equatorial Forest (Lake Tumba; Zaire). Ecology of Food and Nutrition. 12:139-153.

POOLEY, E S (1978) A checklist of the plants of Ndumu Game Reserve. Jl. S A Bot. 44:1-54.

POOLEY, E S (1980) Some notes on the utilization of natural resources by the tribal people of Maputaland. pp. 467-479. in "Studies on the Ecology of Maputaland" edited by Bruton, M N and Cooper, K H, Cape and Transvaal Printers, Cape Town.

POULTNEY, C (1980) Subsistence and utilization of resources by the inhabitants of the Mthikeni/Nsimbi pans region of the Pongola floodplain. (HSRC/CSIR unpublished report).

SANTOS OLIVIERA, J and FIDALGO DE CARVALHO, M (1975) Nutritional value of some edible leaves used in Mocambique. Economic Botany 29:255-263.

TAYLOR, D R F (1970) Changing food habits in Kikuyuland. Canadian Journal of African Studies 4:333-349.

(1974) Land reform in Kenya : a reappraisal. Rural Africana. 23:79-90.

THIBODEAU, F R and OSTRO, B D (1981) An economic analysis of Wetland Protection. Journal of Environmental Management. 12:19-30.

THORRINGTON-SMITH, ROSENBERG and McCRYSTAL (1978) Towards a plan for KwaZulu. The preliminary development plan. KwaZulu Government, Ulundi.

TINLEY, K L (1977) Framework of the Gorongosa ecosystem, Mocambique. Hennies Printers, Pretoria. 193 pp.

(1979) the maintenance of wilderness diversity in Africa in Voices of the Wilderness edited by I Player pp. 29-42. Proceedings of 1st World Wilderness Congress. Johathan Ball Publ.

TINLEY, K L and VAN RIET, W F (1981) Tongaland, zonal ecology and rural land use proposals. Unpublished report (186 pp) to the Department of Co-operation and Development, Pretoria, South Africa.

VAN DER MERWE, A LE R, BURGER, I M AND WEHMEYER, A S (1967) Suid-Afrikaanse Veldkosse : I Makatini vlakte, Noord Natal. Nasionale Voedingsnavorsingsinstituut.

VAN VOORTHUIZEN, E G and ODELL, M (1976) Thatching in Botswana: the Social-Ecology of Traditional Construction. Botswana Notes and Records 8:165-174.

WHITE, R (1979) A handbook for village woodlot planning and management in Botswana. Government Printer, Gaberone.

WILDLIFE SOCIETY (1980) A policy and strategy for environmental conservation in South Africa. Wildlife Society of South Africa, Durban.

ACKNOWLEDGEMENTS

This paper and the project, would not have been possible without the encouragement, help and discussion of many people or without permission from the KwaZulu Bureau of Natural Resources and the Tembe Tribal Authority. In particular, I must acknowledge the contribution of H C Bourn, I Gumede, B R Gwala, M Gwala, B Khosa, M Khumalo, S J Jhumalo, P McLaren, J Ncube, J Ngcobo, A Ntombela, B Ntuli, J Nxcamu, Z Nyathi, the staff of "Ngezandla Zethu" and the late A Vilane. However, the views expressed here do not necessarily reflect the opinion of any of the above organisations or individuals. The help of my supervisor, Professor E J Moll, in providing comments on the manuscript is appreciated.

SECTIONS B & C

PALM WINE : ECONOMIC VALUE AND USE

"The sea Dyaks are much given to the making of feasts to which they dedicate themselves with great enthusiasm. At such times, they give themselves over to interminable ceremonies accompanied by music, song and banquets, with a profusion of viands interspersed with frequent libations of palm-wine and arrak".

Beccari (1877) Malesia, Genova

in Gibbs (1911)

PALM WINE TAPPING IN MAPUTALAND, SOUTH AFRICA.I : CONTRIBUTION TO THE REGIONAL RURAL ECONOMY

A.B. CUNNINGHAM [1]

ABSTRACT

Palm wine tapping is one of the major uses of the Hyphaene natalensis palmveld on the Maputaland coastal plain, South Africa. During 1981 - 1983, sales of palm wine were monitored at informal rural marketing points to determine the economic value of this resource, the volume of palm wine sold and its distribution in the area. Nearly 1 000 000 litres of palm wine were sold during the 12 month period from November 1981 - October 1982, generating R157 732 from sale, transport and re-sale. This provides the first quantitative assessment of the regional economic value of palm wine sales in a rural African community and perspective on one of the uses of a marginal agricultural potential area.

INTRODUCTION

Hyphaene natalensis O. Kuntze characterises the 156 000 hectares of palmveld which extend down the coastal plain in Natal, South Africa (Moll, 1972). This low agricultural potential area is under increasing socio-political pressure for development. One recommendation has been for the afforestation of the palmveld (Loxton et al. 1969, Thorrington Smith et al. 1978).

Another more recent plan by Tinley and van Riet (1981) has recommended that the area should be maintained in a semi-

1 Botany Department, University of Cape Town
RONDEBOSCH, 7700

natural state as a tribal resource area and has put an emphasis on the development of locally available resources. However, when these recommendations were made, little was known of the existing value of this multiple-use area to the Zulu people for cattle-grazing, palm wine tapping and as a source of weaving material, veld-foods, thatch and firewood.

Transformation of a multiple-use area under subsistence use to a monoculture for commercial purposes (timber) would result in a reduction of biological diversity and land-use options. Knowledge of existing land-use values is necessary to give perspective for land-use planning and to avoid the adverse impact which can result from insensitively planned development schemes (Taylor, 1974; Fleuret and Fleuret, 1980; Joseph, 1981).

One of the major uses of the 25 600 hectares of palmveld in the study area is palm wine tapping. Sale of home brewed alcoholic beverages is an important activity in Maputaland and palm wine is the most commonly sold "beer" (Felgate, 1965, 1982; Poultney, 1980). This paper describes a detailed investigation of the palm wine industry in the area to assess the economic importance of this activity and to provide baseline data on the magnitude of sales and sales distribution for resource management.

Figure 1 Distribution of major sale (●) and re-sale (▲) points for palm wine tapped in the H.natalensis palmveld in Natal, South Africa. Palmveld mapped by Moll, 1972.

METHODS

During initial fieldwork in 1980 and early 1981 palm wine sale and re-sale points in the region were identified (Figure 1). Four major sale points were sited in the study area (Cunningham, in prep. a). After 12 months in the study area when local people had become more familiar with the project, a series of meetings was held at the Tembe Tribal Authority offices to obtain permission from the Chief and his headmen to do a survey of palm wine sales. Meetings were also held at the sale points to explain that permission had been given for the survey to be done, and why it was being done. Initially there was considerable suspicion at the Phelendaba sales point but with support from the tribal authority, suspicion gradually decreased during the first few weeks of monitoring. The original idea of employing only local people living near each of the sale points to monitor palm wine sales was difficult to implement due to the low literacy rate in the area. Although selected local people monitored palm wine sales at Zangomeni, Phelendaba and eSicabazini, they needed assistance at two sale points (Phelendaba and eSicabazini) due to the number of containers sold. These supplementary enumerators were young Zulu men working for the Bureau of Natural Resources who were chosen for their reliability and good relations with local people at the sale points. Palm wine sales from Sihangwana were monitored by these staff members without help from local enumerators.

Although monitoring started in September 1981, data collected during this period was not used due to possible bias from local suspicion or from the enumerators getting used to the data collection sheets.

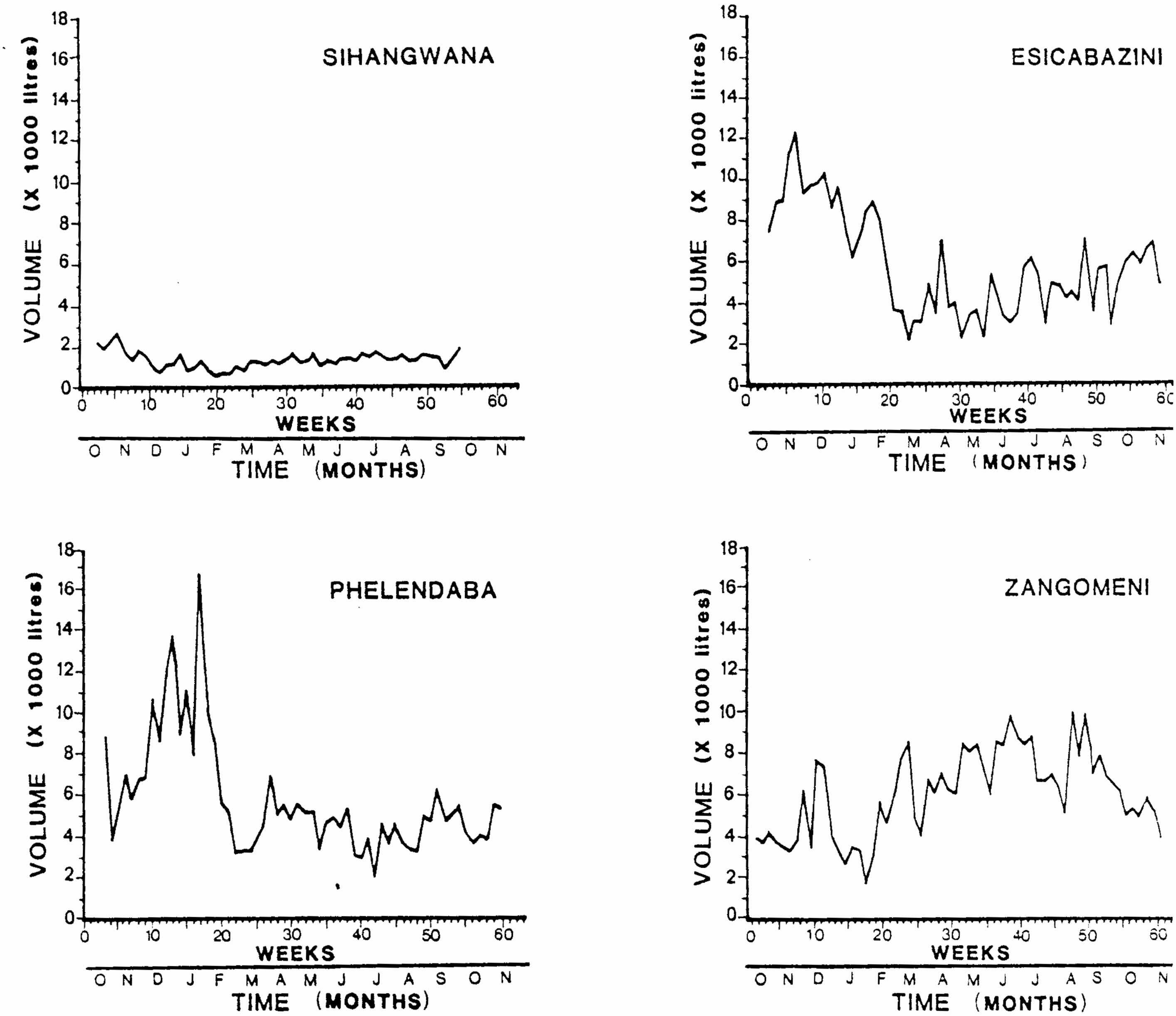
Monitoring started three months after the first meeting with the Tribal Authority. The monitoring of palm wine sold from the sale points was recorded in a standard way (Appendix 1) on a daily basis for 14 months (1 600 days) and on a weekly basis at one of the main sale points for a further 7 months. Field assistants recorded the volume of palm wine sold, the re-sale point it was distributed to and the extent of local sales. During the 12 month period (November 1981-October 1982) taken to represent annual sales volume, all sale days were monitored at Sihangwana, 96.2% at eSicabazini, 92.9% at Phelendaba and 95.9% at Zangomeni. Sales on the remaining days were estimated from the mean of minor (Tuesday, Thursday, Saturday) or major (Monday, Wednesday, Friday) sale days for that particular week. The help and confidence of local people familiar with the first phase of fieldwork was invaluable. Without this and the emphasis on good public relations this survey would have been impossible.

RESULTS

Income is generated through the sale of undiluted palm wine within the palmveld area (primary sales), its transport, and from the re-sale of dilute palm wine (secondary sales) outside the palmveld area. The economic value of the palm wine industry was calculated for primary sales according to the current price/volume for palm wine. The value of secondary sales was determined from information collected on the costs of transport and sugar (which is added to dilute palm wine prior to re-sale) assuming a 50/50 dilution factor with water. Palm wine is diluted to increase volume (and the profit margin) of palm wine for re-sale but is kept at a dilution of half water / half palm wine by consumer demand. If there is too much water, people will not buy from that particular seller. If there is too little water, the seller does not make a profit. Therefore the 50/50 dilution rate is kept fairly constant.

Primary Sales

Local sales occurred daily but only accounted for a small percentage of total sales. Major sales occurred on alternate days (Monday, Wednesday, Friday). On rainy days, sales did not occur or were low. No palm wine was sold on Sundays. Most palm wine was sold to people from outside the area for re-sale. Regular sales occurred at four sale points (Sihangwana, eSicabazini, Phelendaba and Zangomeni). Monitoring of these points on a daily basis for 14 months (October 1981 - November 1982) (Figure 2) and weekly at eSicabazini for a further 7 months (Figure 3 b) showed the volume of palm wine sold. During the year November 1981- October 1982, nearly 1 000 000 litres of palm wine were sold from these sale points (Appendix 2).



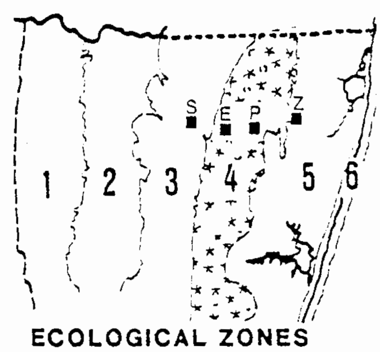
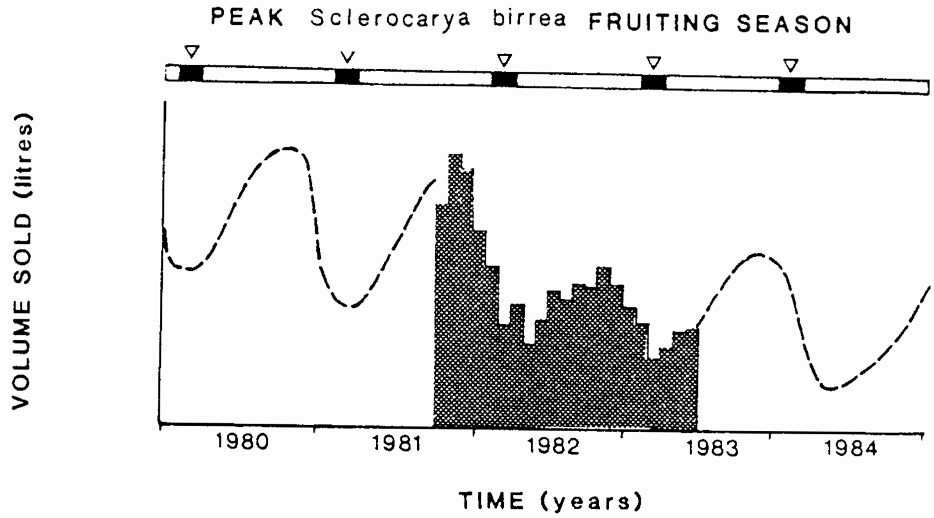


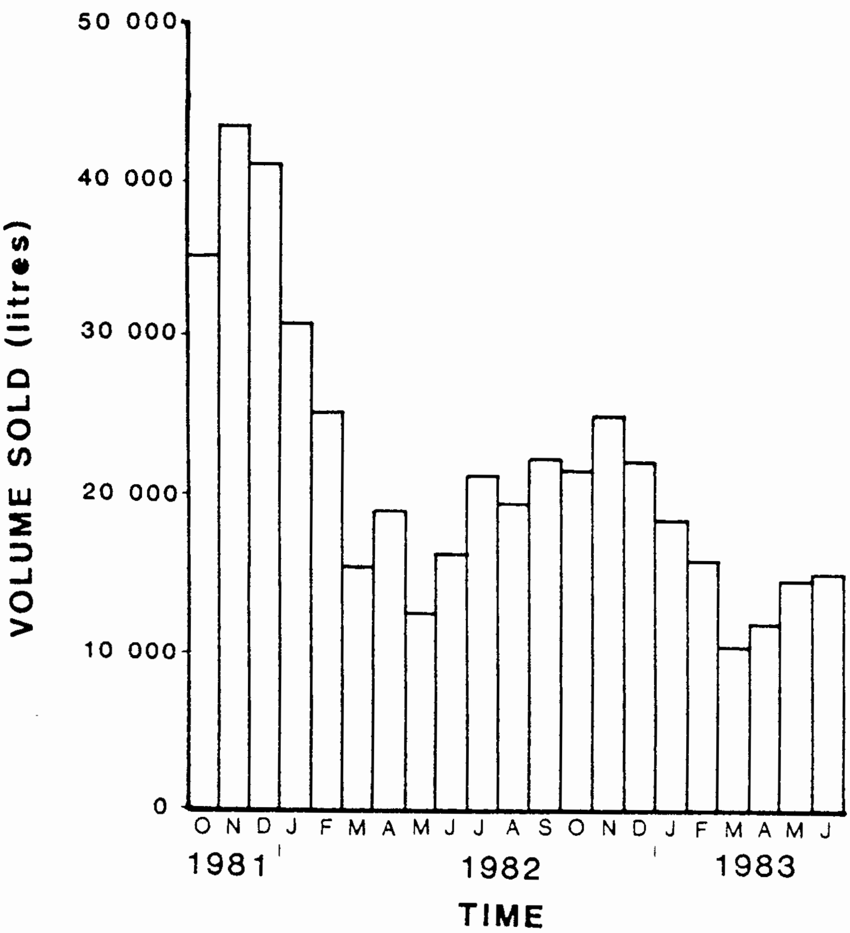
Figure 2 Total weekly volumes of palm wine sold at four sale points from November 1981 - October 1982, and their position in relation to the boundaries of the Mosi-Palm ecological zone drawn by Tinley and Van Riet (1981) (Sihangwana (S) eSicabazini (E) Phelendaba (P) and Zangomeni (Z)).

Sihangwana	62 386 litres
eSicabazini	288 136 litres
Phelendaba	303 001 litres
Zangomeni	319 384 litres

Zangomeni was both a sale and a re-sale point selling pure and diluted palm wine, but it was not possible to distinguish between this during winter when sales from the three other points were low (Figure 2; Appendix 2). Dilution and re-sale substantially increase the economic value of palm wine. As it was not always possible to distinguish between the sale of pure and dilute palm wine from Zangomeni, re-sale figures for this sale point were not included in re-sale values for the region. Sales from Phelendaba and eSicabazini (and to a lesser extent the Sihangwana sales) show a distinct peak in summer, a rapid drop in February/March and an increase during April to a level fluctuating up to the following summer peak (Figures 3 a and b).

A wide variety of sociological, environmental and technological factors influence palm wine sales and can account for the fluctuations shown in weekly trends (Figures 2 a-d). The most significant of these is in February - March when Sclerocarya birrea **A. Rich) Hochst.** trees bear fruit after permission is given by the headman of the area, a popular beer (ubıganu) is brewed. This alternative alcohol source results in a sharp decline in palm wine sales at this time. During the





<u>Figures 3 a and b</u> Palm wine sales from eSicabazini over a 21 month period (October 1981 - June 1983) showing sales trends peaking during spring/early summer, followed by a rapid decrease in sales during <u>Sclerocarya birrea</u> fruiting time (February - April) when marula beer is brewed throughout the region.

November to January period, the hot weather, the increase in returning migrant labourers and possibly the effect of past rainfall on the height of the water-table also played a role in boosting sales (Figure 3 a).

Palm wine sales are also periodically affected by transport problems. The vehicles involved in transporting palm wine were old and in need of constant maintenance due to the poor quality roads. Only a few vehicles were involved in transport, and the breakdowns witnessed undoubtedly had an influence on sales. Other factors can only be speculated on. For example, during July 1981, prior to the onset of monitoring, Chief Gumede ruled that no beers fortified with sugar during fermentation could be brewed for sale in his area (Siphondweni). Palm wine was considered to be a more suitable beverage and this resulted in an increase in the sale of palm wine and a decrease in the sale of other beers.

Transport

After initial sale, palm wine is transported to centres outside the palmveld zone for re-sale, either on foot or in vehicles (Figure 5). The trucks used run as general transport businesses, transporting people, palm wine, building materials and other goods. Most palm wine is transported for re-sale to KwaNgwanase, Ndumu, Ingwavuma, and Phondweni (Table 1 and Figure 4).

TABLE 1. Destination and volume of palm wine transported for re-sale from three sale points in the study area during the year November 1981 - October 1982. Total sales during the year were 976 632 litres of palm wine.

Resale point	Volume transported	Percentage of total cost
KWANGWANASE	144 150	14,8
NDUMU	118 159	12,1
INGWAVUMA	79 909	8,2
PHONDWENI	67 201	6,9
KWA-MBOSI	29 821	3,1
BHEKABANTU	13 048	1,3
ZANGOWENI	12 466	1,3
KWA-LULWANE	8 311	0,9
MAKWAKWA	8 158	0,8
KWA-ZAMAZAMA	3 917	0,4
KWA-NODINEKA	3 042	0,3
JOZINI	1 697	0,2

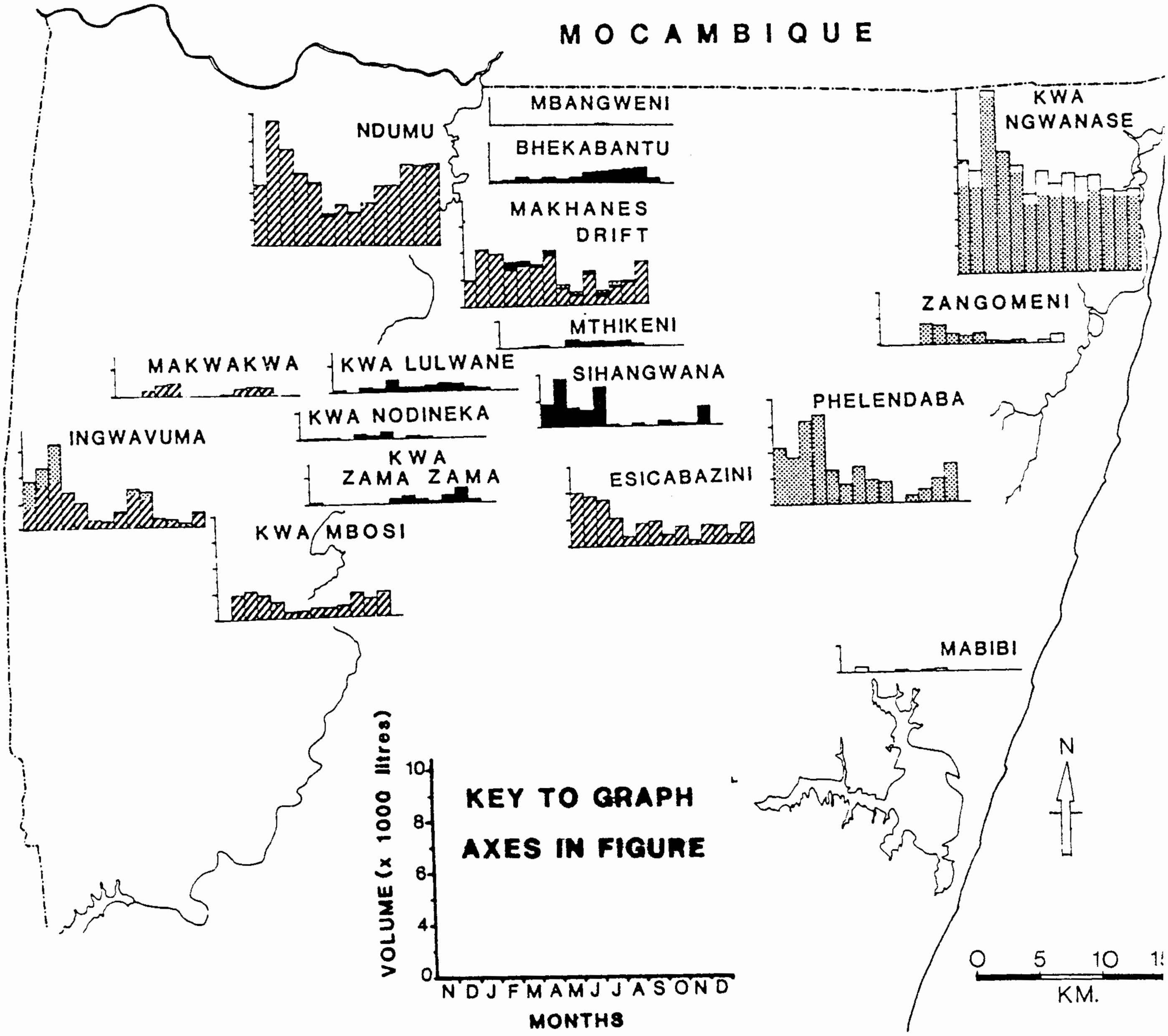


Figure 4 A diagrammatic representation of post-sales distribution over a 14 month period (November 1981 - December 1982) for palm wine from three sale points (Sihangwana, eSicabazini and Phelendaba) in the Maputaland area. Sales from Zangomeni were not included as it was both a sale and a re-sale point, but sales to Zangomeni are shown. Shading denotes source of the palm wine (Sihangwana ■, eSicabazini ▨ and Phelendaba ░).

Figure 5 Most palm wine transport to resale points outside the palmveld zone is done with locally owned vehicles.

Figure 6 Re-sale of palm wine at a village market (KwaNgwanase). Palm wine is usually sold in 1 litre jars (iziNsulumpha) either from 25 litre plastic containers (iziPakupaku) or from 20 litre glass bottles (amaGunklu) similar to the one figured above.

Eight vehicles were regularly involved in transporting palm wine; either at the request of groups of women selling palm wine for re-sale for their own profit or for people who had bought palm wine at the primary sale points themselves. These local entrepreneurs charge a set price per volume, dependent on the distance transported (Appendix 3).

The eSicabazini sale point supplies areas to the west of the palmveld zone (Ndumu, KwaMbosi, Ingwavuma), Phelendaba areas to the east (Zangomeni, KwaNgwanase) and Sihangwana the re-sale points along the Pongolo floodplain (KwaLulwane, KwaMbosi, Bhekabantu, KwaNodineka) (Table 1 and Figure 4). These sale points also supply the local areas (Figure 4).

Assuming that quantities less than 1 000 litres/year were accounted for by casual buyers transporting palm wine for their own use, rather than for commercial gain, then commercial sales represent 50,2% of total annual sales (i.e. 489 879 litres/year).

Local sales were assumed to be for consumption at home or at the primary sale points (where social gathering takes place) or for use as payment for various services (e.g. agricultural activities, hut-building or moving huts to a new site). Although transport of palm wine on foot for commercial resale recorded by Felgate (1965 , 1982) is still practised in the study area, this was regarded as "non-commercial sale" as it was not always possible to separate

Table 2 Total cash returns to entrepreneurs transporting palm wine from Sihangwana (2 vehicles), eSicabazini (3 vehicles) and Phelendaba (3 vehicles) estimated from palm wine sales data and transport costs (Appendix 3). Only volumes more than 1 000 litres/year were considered to comprise commercial transport. Total profits were R15 188,88 (Sihangwana R54,00, eSicabazini R8 431,89 and Phelendaba R6 210,90.

RE-SALE AREA / SALE POINT	KWA NGWANASE	ZANGOMENI	MTHIKINI	KWA LULWANE	KWA NODINEKA	BHEKABANTU	MBANDLENI	KWA ZAMA ZAMA	PHONDWENI	KWA-MBOSI	MAKWAKWA	NDUMU	INGWAVUMA	JOZINI
SIHANGWANA			R31,80	R99,73	R39,30	R156,57		R125,34	R 62,29			R 31,06		
ESICABAZINI	R 8,96						R18,57		R1 591,20	R843,80	R228,41	R4 176,28	R1 564,67	
PHELENDABA	R4 027,20	R195,20							R 52,56				R1 624,69	R311,25
TOTAL VALUE (RANDS)	R4 036,16	R195,20	R31,80	R99,73	R39,30	R156,57	R18,57	R125,34	R1 706,05	R843,80	R228,41	R4 207,34	R3 189,36	R311,25

the commercial and non-commercial sales when transported on foot. Therefore re-sale profits may be under-estimated.

Regional profits from vehicle transport of palm wine can be estimated from data for each sale point (Table 2). Gross profits for transport amounted to R15 188,00 (Phelendaba : R6 211; Sihangwana : R546; eSicabazini : R8 432) for the year November 1981 to October 1982.

Resale

As found by Felgate (1965, 1982) and Poultney (1980) palm wine sale and re-sale was a very important income generating activity during the study. After transport to the re-sale point, the palm wine is diluted with water, sugar is added, and fermentation continues. Fifty to 60 litres of beer were sold daily at these homesteads (Poultney, 1980) or at informal markets (Figure 6).

Assuming an average transport cost of R1,40 per 50 litres (which would not be accrued if palm wine was transported on foot) and a cost of 60c for the sugar added to this quantity of palm wine, then with a 50/50 dilution, re-sale of palm wine would bring in a profit of R3,00 per 50 litres. This is similar to Poultney's (1980) estimate of R4,00 per 60 litres of beer in the Siphondweni area of the Pongolo floodplain. Poultney (1980) did not take transport costs into account, as most palm wine was transported on foot

TABLE 3. The regional value of the palm wine industry in the study area during the 12 month period November 1981 - October 1982.

Activity	Regional Income R	Estimated number of people involved	Estimated income/ person/ year* R
Palm wine tapping	113 152	400[1]	190[2] - 590[3]
Resale	29 392	54 - 65	452 - 544
Transport	15 188	8 - 12	1 260 - 1 890
TOTAL	157 732	462 - 477	

* From palm wine sales. Other income would accrue to transport entrepreneurs, but seldom to full-ime tappers/sellers.

1 = 200 tappers + 200 sellers
2 = Income to average palm wine seller
3 = Income to average palm wine tapper
(Data for 1-3 from Cunningham, in prep. (a)).

to this area from Mpophemeni and this could account for the slightly higher profit margin.

If sales are for 300 days/year then approximately 15 000 - 18 000 litres of dilute palm wine are sold by each homestead annually. The 489 879 litres of undilute palm wine transported commercially would, therefore, support beer sales at 54 - 65 homesteads in the Ingwavuma district. At R3,00 per 50 litres of <u>dilute</u> palm wine this would generate R29 392 / year within the region, or R452 - R 544 /homestead/year.

Palm wine tappers spread throughout the 17 500 hectares of palmveld within the study area generated regional economic input of nearly R158 000 through primary sales transport and re-sale of palm wine (Table 3).

DISCUSSION

Large scale commercial tapping and sale of palm wine is recorded from West Africa (Tuley, 1965) and south-east Africa (this study and Cunningham in prep. a). Tuley (1965) provides no quantitative evidence to support his estimate of the regional value of palm wine sales in Nigeria (£6 million per annum). However his paper does give an indication of the magnitude of sales in Nigeria, where income to tappers (Okafor, 1980) is considerably higher than in my study area, primarily because of the high yields from the large palms tapped there (see discussion in Cunningham, in prep. a).

A major advantage of the palm wine resource is its year-round availability. A major limitation in the past was access to a market for palm wine. The main limitation now is the small size and low yields of the palms (Figure 7) (Cunningham, in prep. a). Oral records indicate that palm wine was available in the 1800's (Webb and Wright, 1976 p. 67). Although vehicle tracks were developed in the area in the early 1900's (von Wissell, undated; Bruton, 1980), lack of locally owned vehicles considerably limited the market for palm wine. Until the mid-1970's, palm wine was transported on foot from markets in the palmveld to re-sale points (Felgate, 1965, 1982) making the potential markets at Ndumu and Ingwavuma inaccessible. Felgate's (1965) excellent description of these informal markets is still relevant today:

> "At first sight the Thonga markets along the bus routes from Mkhuse to Maputa[1] are a striking feature to the newcomer. At these markets anything between 10 and 30 women are present, each one sitting with her wares spread out in front of her, awaiting the arrival of the bus which will bring back to Tongaland men returning home after a spell of work in town.
>
> All manner of produce is sold at these markets. The most commonly sold items are sweet potatoes, maize on the cob that has been roasted or boiled, mahewu (light beer), ubusulu, and occasionally cooked meat and fish and quite frequently a home made type of scone".

1. Now KwaNgwanase

Figure 7 Palm wine tapper collecting sap from an *H.natalensis* stem showing the low yield (in glass container) and the small size of the palm stems tapped and available for tapping (background).

A major change since this time has been the wider distribution of palm wine across the Ingwavuma district. Felgate (1965, 1982) recorded in 1964-1965 that:

> "As a mechanism of effecting some kind of balance between the ecological zones and as a mechanism of property distribution, these markets play a very insignificant role in Thonga society. In the first place they are confined mostly to the bus routes and they are aimed at extricating from the pockets of the returned migrants the cash that they bring with them; in the second place the quantities of goods that can pass through these markets can make no appreciable difference to the total Thonga economy. In southern Tongaland, in the Lake Sibayi region, in the Pongola river region and also in southern Mozambique, there are no markets ".

Since then, as local people frequently pointed out

> "there is an increasing number of middlemen who, through prolonged periods of migrancy working in towns, on farms or in the cities, have been able to purchase pick-up trucks" (Poultney, 1980).

Upgrading of the main road infrastructure since 1974 and the current tarring of the KwaNgwanase-Ingwavuma-Jozini road (which commenced in 1982) has catalysed small-scale rural marketing, reducing vehicle maintenance costs and improving access to external markets for goods sold at informal markets, including palm wine. The same markets described by Felgate (1965, 1982) are now providing an important input into the local economy and are widespread in the area. Even in the short time since the end of monitoring palm wine sales, sale points that only marketed palm wine intermittently from 1981-

1983 are now (1984) the site of regular sales because of the proximity of the newly tarred road. The KwaNondwayisa sale point (see Cunningham, in prep. a) is a good example of this.

During 1982, reed sales from Phelendaba (R38 000, 260 ± 60 metric tons) (Cunningham, in prep. b) and palm wine sales injected a large amount of money into the regional economy with this increase in transfer of goods across the ecological zones. However, while sale and re-sale of palm wine generates a significant amount of cash within the regional economy, this is split between a wide range of middlemen/women, so that individual profits are low (Table 3 and Cunningham, in prep. a). Income from the palm wine sales, for example, is split between tappers, women transporting palm wine to selling points, vehicle owners and re-sale entrepreneurs - an estimated 460 - 480 people. This reduces individual profits, but enables more people on the "poverty line" to have the option of a subsistence income.

Although individual profits are low (Table 3), average per capita income in the study area is certainly lower. In the adjacent Mseleni area, per capita income (including pensions) is R75 per annum (Mann, 1984). Income generated from palm wine sale, transport and re-sale has more local importance than may be realised by urban orientated planners.

Ultimately the majority of the income from palm wine sales is spent in stores, but access to external (re-sale) markets and transport has lengthened the chain of cash flow amongst local people since Felgate's (1965) study. Although palm wine sales only provide a subsistence income, palm wine tapping is an important local alternative to migrancy and a buffer against extreme poverty. Consequently the larger size classes of palms are under increasing pressure as a resource. Although there are factors providing some limit to over-exploitation, pressure on the palm resource needs to be relieved if it is to remain an effective buffer against rural poverty (Cunningham, in prep. a).

The average rate of population increase in the Maputaland area is 2.67% per annum, with an estimated population density of 44,4 people per km. by 2 000, compared with an average figure of 24,3 people per km. in 1980 (Bruton, 1980). Due to the low potential for agriculture, mining or industry (Loxton et al., 1969; Thorrington-Smith et al., 1978; Bruton, 1980) creation of local employment cannot keep up with the population growth. Twenty years ago there was already a 73% level of migrant labour in the Kosi section of my study area (Felgate, 1965). This is more evident today. Even on the more fertile Pongolo floodplain migrancy is high, increasing during drought periods from 55% (in 1978/1979) to 84% in 1983 (Derman and Poultney, 1984).

If educational and living standards are to increase to a level where the population growth rate starts to decrease, political commitment to co-ordinated development is necessary. Development plans and their implementation also have to be sensitive to environmental constraints as well as to the needs of the people. If they are not, there will be closure of the few options that are available from this marginal area. If the palmveld was put under afforestation as Loxton et al. (1969) recommended, the palm wine tapping option would be reduced or lost. Development of the tourism-conservation land-use option suggested by Tinley and van Riet (1981) and Ferrario (1981) avoids this, keeping options open for the future. However resource management is necessary and complex (Cunningham, in prep. a). In order to avoid long-term detrimental ecological, economic and sociological repercussions and to direct the limited amount of manpower and money available for development effectively, it is essential to weigh up the advantages and disadvantages of the various land-use options. This economic evaluation of the palm wine industry provides a basis for a cost-benefit comparison with afforestation in the Ingwavuma district (Cunningham, in prep. c). It also puts a different perspective on one of the multiple of uses of the palmveld area in its existing state.

CONCLUSION

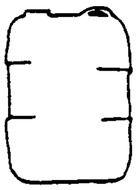
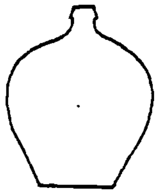
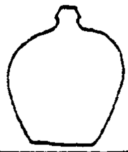
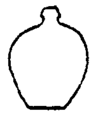
The palm wine industry has developed primarily because of the abundant resource base (the Hyphaene palmveld and abundance of Phoenix palms) and the year-round availability of palm wine coupled with the tapping skills of the Zulu and Thonga people. An increasing number of former migrant labourers have acquired vehicles since the late 1970's. This has enabled them to generate income as entrepreneurs transporting commodities in the area, including palm wine. It has also provided access to re-sale markets for palm wine that were inaccessible to women transporting palm wine on foot. Tarring of the major road links has further catalysed informal sector marketing. During a twelve month period (November 1981 - October 1982), 972 907 litres of palm wine sold generated nearly R158 000 through sale, transport and resale, providing income for nearly 500 people.

Appendix 1 Data sheet used by field assistants monitoring palm wine sales. Place, name of enumerator and date of sale were recorded in the top line, destination of the palm wine in the right-hand column. The drawings show the different container types used for transporting palm wine for re-sale. Each has a specific Zulu name. From left, the largest (25 litre) isiPakupaku (izi-(plural)); the 20 litre iGunklu (ama-(pl.)); the (12 litre) iMphiselo (izi-(pl.)) and the 5 litre isiBhakela (izi-(pl.)). The three containers on the right are glass containers bought in Mozambique prior to the closure of the border and are less commonly used. However plastic containers of the same volume are known by the same names. Enumerators recorded the number of containers sold and whether they were full, half full etc. to enable a daily assessment of the volume of palm wine sold to be obtained.

2

INANI LOBUSULU ABUKHIWAYO

INDAWO: S'Cqabuzini   IGAMA: Jo Khumalo   USUKU: 25/ 7/ 83

				
iziPakupaku	amaGunklu	iziMphiselo	iziBhakela	
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |	| | | | | | |	| | | | | | | | |	| | |	isiDumo izipakupaku 42 isiDumo amaGunklu 2 isiDumo izimphisela 5 mathunthu izipakupaku 15 mathunthu izimphisela 4 mathunthu iziBhakela 3
58	7	9	3	

Appendix 2 Monthly volumes and total volume of palm wine sold at sale points in the study area during the 12 month period November 1981 - October 1982.

	SIHANGWANA	ESICABAZINI	PHELENDABA	ZANGOMENI	TOTAL SOLD IN STUDY AREA (litres)
NOV	8267.6	43841.2	26088.6	17029.2	95226.6
DEC	4991.3	41248.9	45738	23220.3	115198.5
JAN	4623.3	30808.2	47102.4	13925.2	95469.1
FEB	3822.2	25306.8	28722.9	19181	77032.9
MAR	3086	14486.2	14945.3	27163.7	59681.2
APRIL	4979	18984.5	24103.6	26886	74953.1
MAY	5179	12632.6	19871	34202.5	71885.1
JUNE	5292	16359.3	26090	35994	83735.3
JULY	5792.3	21230.2	13578	32572.5	73173.0
AUG	6002	19408.6	15626	30622.7	71659.3
SEPT	5567	22307.8	21540	34801.5	84216.3
OCT	4784.8	21521.4	19595	24774.9	70676.1
ANNUAL TOTAL PER SALE POINT (ℓ)	62386.5	288135.7	303000.8	319383.5	972906.5

APPENDIX 3

Transport costs and volume of palm wine transported to various re-sale areas. Separate volumes are given for November 1981 - August 1982 (sales price 10c per litre) and September 1982 - October 1982 after a price change to 20c per litre. Transportation of less than 1 000 litres/year was assumed to be for non-commercial purposes and was taken into account in calculation of transport costs. These places are indicated by asterisks in the table.

SIHANGWANA (41 152 litres)	MTHIKINI	KWA-ZAMA ZAMA	KWA LULUWANE	BHEKABANTU	KWA-NODINEKA	OTHOBOTINI*	KWA-MBOSI*	PHONDWENI	EMBANGWENI*	INGWAVUMA*	NDUMU	PONGOLA*
November 1981 - August 1982	3 700	3 917	7 595	9 779	3 042	54	209	6 232	182	175	1 155	50
September 1982 - October 1982	225		716	3 269				855				
Transport costs per 25 litres	20c	80c	30c	30c	30c	R1,00	70c	20c	30c	80c	80c	20c

ESICABAZINI (251 836 litres)	MBANDLENI*	KWANGWANASE*	ZANGOMENI*	JOZINI*	GAMBULIZETA*	MAKWAKWA	KWA-MBOSI	PHONDWENI	MANYISENI*	INGWAVUMA	NDUMU	GOLELA*
November 1981 - August 1982	664	320	266	190	326	5 667	23 441	46 444	85	37 692	92 317	313
September 1982 - October 1982						2 491	5 857	10 385		1 425	23 691	
Transport costs per 25 litres	70c	70c	50c	R1,00	70c	70c	90c	70c	-	R1,00	90c	-

PHELENDABA (204 219 litres)	MSELENI*	KWANGWANASE	ZANGOMENI	JOZINI	NONGOMA*	MKUZE*	KWA-MBOSI*	PHONDWENI	UBOMBO*	INGWAVUMA	NDUMU*	PONGOLO*
November 1981 - August 1982	100	143 580	11 950	1 245	500	400	523	1 356	499	35 009	596	24
September 1982- October 1982		250	250	262				1 929		4 608	400	
Transport costs per 25 litres	60c	70c	40c	R1,00	-	-	40c	40c	R1,00	R1,00	R1,00	40c

LITERATURE CITED

Bruton, M.N. ; M. Smith and R.H. Taylor. 1980. A brief history of human involvement in Maputaland p. 432-459 In Studies on ecology of Maputaland, M.N. Bruton and K.H. Cooper ed . Cape and Transvaal Printers, Cape Town.

Bruton, M.N. 1980. Conservation and development in Maputaland In Studies on the ecology of Maputaland, M.N. Bruton and K.H. Cooper. Studies on the ecology of Maputaland. Cape and Transvaal Printers, Cape Town.

Cunningham, A.B. in prep a. Palm wine tapping in Maputaland, South Africa II. Yields, individual profits and carrying capacity.

Cunningham, A.B. in prep b. Commercial harvesting of Phragmites australis reeds in a low agricultural potential area.

Cunningham A.B. in prep c. Multiple use vs. afforestation - an economic evaluation of palmveld in Maputaland, South Africa.

Derman, P. and Poultney, C. 1984. The politics of production and community development in rural South Africa. Carnegie Conference paper No. 226. Second Carnegie Inquiry into Forestry and Development in Southern Africa. 13 - 19 April 1984, Cape Town, South Africa.

Felgate, W.S. 1965. An ecological study of the Tembe-Thonga people. Unpublished report on research work, edited by E.J. Krige. 167 pp.

Felgate, W.S. 1982. The Tembe-Thonga of Natal and Mozambique : an ecological approach. Department of African Studies, University of Natal, Durban, Occasional Publications No. 1.

Ferrario, F.F. 1981. An evaluation of the tourist potential of KwaZulu and Natal. KwaZulu Development Corporation, Durban.

Fleuret, P. and Fleuret, A. 1980. Nutrition, consumption and agricultural change. Human organization 39 : 250-260.

Joseph, F.G. 1981. Influence of development factors on nutritional patterns in the Solomon Islands. Ecology Food Nutr. 10 : 187-191.

Loxton, R.F., Hunting and Associates. 1969. The natural Resources of Maputaland. Map series (1 : 100 000) and schedules. Unpublished.

Mann, D. 1984. Aspects of the social effects of Mseleni joint disease. Carnegie conference paper No. 191. Second Carnegie Inquiry into Poverty and Development in South Africa. 13-19 April 1984, Cape Town, South Africa.

Moll, E.J. 1972. The distribution, abundance and utilization of the Lala-palm, Hyphaene natalensis in Tongaland, Natal. Bothalia 10 : 627-636.

Okafor, J.C. 1980. Edible indigenous woody plants in the rural economy of the Nigerian Forest Zone. Forest Ecol. Manage., 3 : 45-55.

Poultney, C. 1980. Subsistence and utilization of resources by inhabitants of the Mthikeni/Nsimbi pans region of the Pongolo floodplain. (HSRC/CSIR unpublished report).

Taylor, D.R.F. 1974. Land reform in Kenya : a reappraisal. Rural Africana 23 : 79-90.

Thorrington-Smith, Rosenberg and McCrystal. 1978. Towards a plan for KwaZulu. The preliminary development plan. KwaZulu Government, Ulundi.

Tinley, K.L. and W.F. van Riet. 1981. Tongaland, zonal ecology and rural land-use proposals. 186 pp. Unpublished report to the Department of Co-operatioin and Development, Pretoria, South Africa.

Tuley, P. 1965. Studies on the production of wine from the oil palm. J. West African Inst. Oil palm Res. 4 : 283-289.

Von Wissel, L.C. undated. Dad's Story. Unpublished manuscript compiled from the notes of L.C. Von Wissel by M.E. Cornish-Bowden and M.L. Heaton. 43 pp.

Webb, C. de B. and Wright, J.B. 1976. The James Stuart Archive of recorded oral evidence relating to the history of the Zulu and neighbouring peoples. Vol. I. University of Natal Press, Pietermaritzburg.

PALM WINE TAPPING IN MAPUTALAND, SOUTH AFRICA. II. YIELDS, INDIVIDUAL PROFITS AND CARRYING CAPACITY

A.B. CUNNINGHAM[1]

ABSTRACT

The resource base for the palm wine "industry" on the Maputaland coastal plain is the high density of Hyphaene natalensis and Phoenix reclinata palms. Individual profits are small, but regional profits from accumulated sales are large. This paper assesses daily palm wine yields, economic returns to tappers and the effects of tapping on palms, putting forward management guidelines for the palm wine resource.

INTRODUCTION

Palms are widely distributed in tropical and sub-tropical areas and are tapped for their sap by rural people throughout most of this range (Gibbs, 1911b; Tuley, 1965 a,b,c,d; Balick, 1979; Fanshawe, 1967; Moll, 1972; Malan and Owen-Smith, 1974 and Williamson, 1975). This ferments readily due to naturally occurring yeasts (Nash and Bornmann, 1973), producing an alcoholic beverage referred to as palm wine, palm beer or palm toddy.

Palmveld dominated by Hyphaene natalensis O. Kuntze covers about 156 000 hectares of the Maputaland coastal plain in Natal, South Africa, between the latitudes 27°02' and

1. Department of Botany, University of Cape Town, Rondebosch, 7700.

28°16'S and longitudes 32°27' and 32°47'E (Moll, 1972). The two palm species in this palmveld, H. natalensis and Phoenix reclinata Jacq, are a source of craftwork weaving material, palm wine and edible fruit. Although hunter-gatherers lived in the area from 90-110 000 years B.P (Beaumont et al., 1978; Beaumont, 1980) their influence on the palmveld since the last interglacial period was probably restricted to occasional fires to improve grazing and attract game or to increase yields of fruit-bearing species stifled by thick grass cover. Hunter-gatherer mobility would have precluded time consuming palm wine tapping, but it could have been practised by more sedentary Iron Age agriculturalists and pastoralists. These people lived in the coastal area about 1500 BP and it is since this period that man has had an increasing impact on the vegetation (Hall, 1980).

At this time the palmveld was probably dominated by tall, single stemmed H. natalensis palms which were able to reach maturity and bear fruit. Since then, the increasing incidence of fire, coupled with the destructive tapping process have resulted in the present structure of the palmveld - short, multi-stemmed palms reproducing by root coppice with few individuals escaping tapping to reach fruiting maturity. The tapping method used has been described by Junod (1927); Heard (1949); Felgate (1965, 1982) and Moll (1968). Like other African rural areas the growing population is undergoing rapid cultural, economic and technological change. With improved roads and transport, trade in palm wine and utilization of both palm species has increased. Sale of palm wine provides an important economic input into the rural economy of this low agricultural potential area (Cunningham, in prep.a).

This paper provides base line data for future resource management, assessing the number of palms tapped annually, the extent of damage to palms, the economic returns to these tappers and estimating the number of tappers working in the study area. Management proposals and a carrying capacity for the area are put forward on the basis of these data.

METHODS

Permission to do a project investigating the resource value of indigenous plants to rural people on the Maputaland coastal plain (Figure 1) was obtained from the Tembe Tribal Council in July 1980.

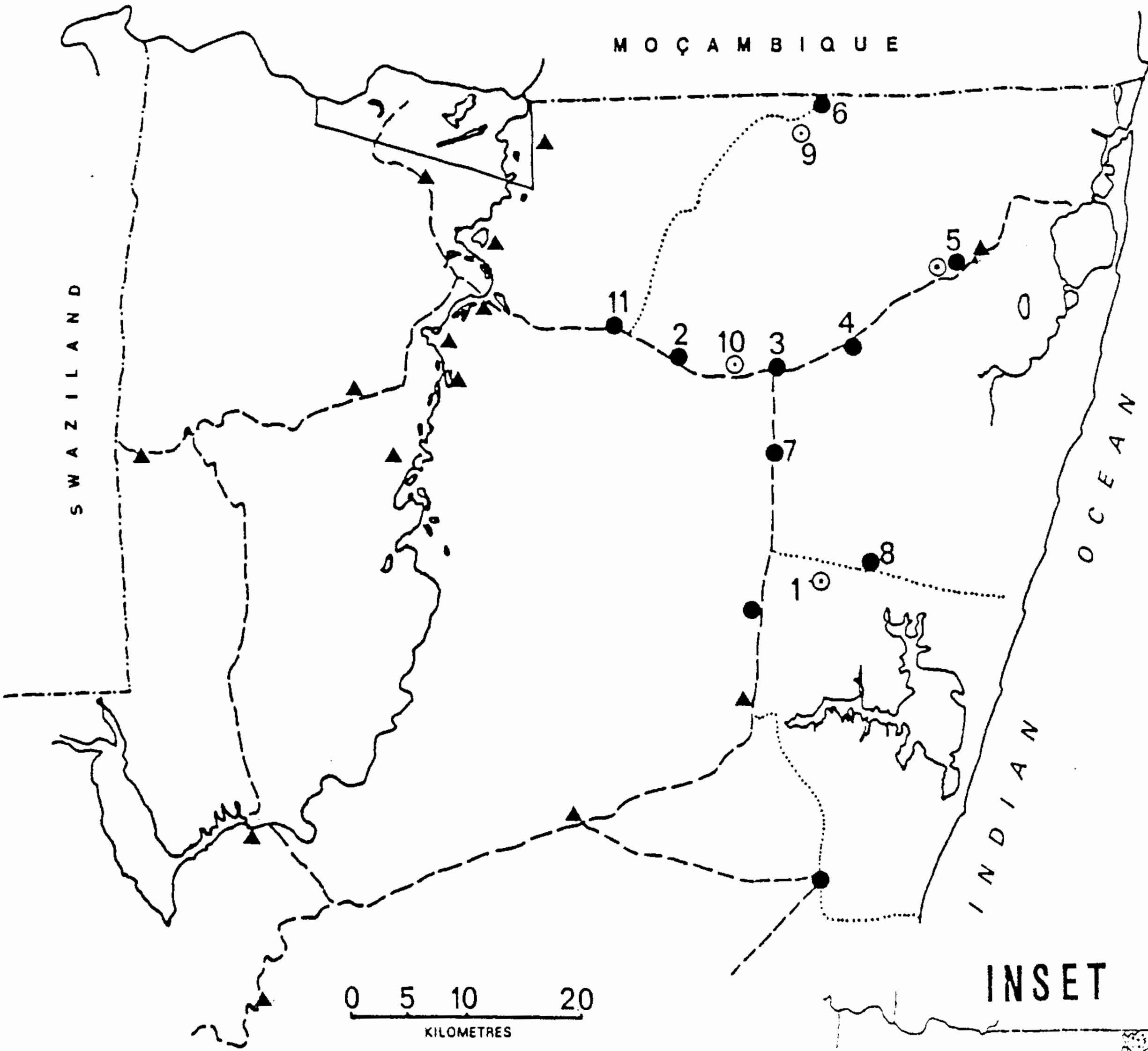
This study was based on interview information backed up by quantified measurements and field observations. Interviews with a range of palm wine tappers were done during the first 15 months fieldwork to determine how many palms tappers were utilising at one time, and to get an estimate of the maximum yield of palm wine from the palms. Interviews are always subject to factors which affect reliability of the information, particularly:

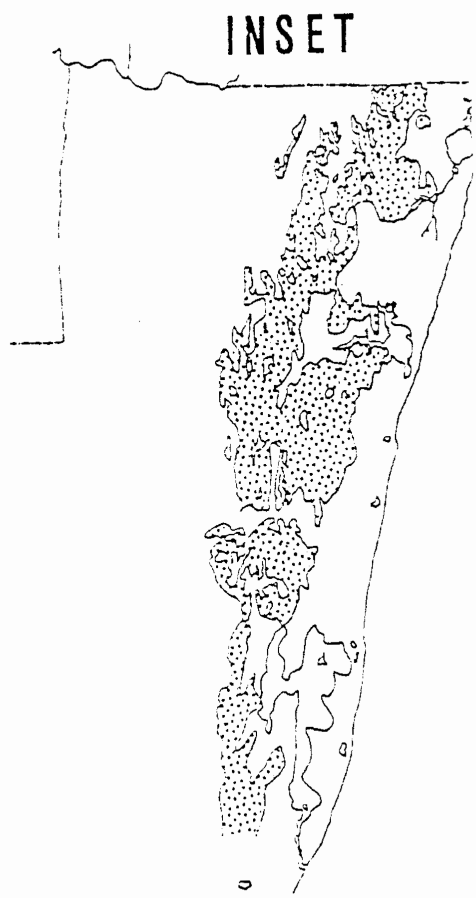
(i) Suspicion as to the motive for questioning, or mistrust of the questioner.

(ii) Misunderstanding, either by the person being interviewed, or the questioner.

Despite my knowledge of Zulu language and custom neither of these factors could be ruled out. Palm wine tappers are extremely suspicious of strangers as there is a widespread fear of ritual murderers in the area. In addition, most palm wine tappers speak poorly pronounced Zulu which is often mixed with Thonga. Therefore interviews were done by a field-assistant from the immediate area who spoke both Zulu and Thonga and had tapped palms himself whilst a herd-boy. The reliability, insight and local knowledge of this man was invaluable to the interview phase of the work. When palm wine tappers were encountered in the palmveld, they were usually willing to help with information, although the interviewer explained to the respondents that they were under no obligation to answer the questions. Interviews were purposely loosely structured, allowing for digression and discussion to put respondents at ease. However, many tappers undoubtedly hid away at the sound of the vehicle and were never seen.

Prior to detailed monitoring of palm wine sales, meetings





SALE POINTS IN THE STUDY AREA ARE NUMBERED.

1 = SIHANGWANE STORE	6 = MUZI STORE
2 = eSICABAZINI	7 = NDLONDLWENI
3 = PHELENDABA	8 = NGUTSHANA
4 = KWA-NONDWAYISA	9, 10 and 11 are
5 = ZANGOMENI	cattle dip-tanks.

SALES AT POINTS 4, 6 - 8 AND AT DIP-TANKS ARE INTERMITTENT.

INSET SHOWS EXTENT OF THE PALMVELD ON THE COASTAL PLAIN (after Moll, 1972).

FIGURE 1. Palm wine sale (●) and resale (▲) points in the Ingwavuma and Ubombo districts of the Maputaland coastal plain.

were held with the Tembe Tribal Council and with people at the palm wine selling points between June and August 1981. Despite 15 months of fieldwork prior to these meetings, there was suspicion that such a study would result in palm wine tapping being stopped, or taxed, particularly at the Phelendaba sale point (Figure 1). These problems were gradually solved, and concurrent monitoring of regional palm wine sales and individual yields started in September/October 1981.

To support the information obtained during the interview phase, palm wine yields and the number of palms tapped by a selected tapper were monitored over a 12 month period. Daily yields from different groups of palms and the different species being tapped were kept separate by the tapper in containers supplied for this purpose. The volume of palm wine was measured daily from each container with a standard 1 000 ml measuring-cylinder (Figure 2).

In the first month, measurements were done personally. During this time, reliable field-assistants monitoring palm wine sales (see Cunningham, in prep.a) were trained to use the measuring cylinder correctly. Subsequent checks were then done on a weekly basis to maintain the quality of the data.

As a measurement of daily palm sap yield this method is crude as it does not measure the flow of unfermented phloem sap (as opposed to palm wine). As a measure of

FIGURE 2. Measurement of daily palm wine yields. Palm wine obtained from separate "batches" of palms was kept in different containers prior to measurement.

palm wine yield to the tapper it is accurate, measuring only the palm wine collected for sale and not the total sap flow, which would include the sap discarded by the tapper as unsuitable for sale. However, the similar trend shown by sap flow measurements from Nipa fructicans **Wurmb.** (Gibbs, 1911a) and Corypha elata **Roxb.** inflorescences (Gibbs, 1911b) and which probably also characterise the sap yield from other species, support the fact that this method gave a good indication of sap flow.

The number of palms being tapped in each "batch" were counted when they were prepared for tapping and the dates when palm sap collection started and ceased, were recorded. Ten months after this phase was completed damage to tapped H. natalensis and P. reclinata plants was determined based on three field assessment categories:

(a) palm and stems dead;

(b) palm recoppicing and/or continued growth of untapped stems, but tapped stem dead;

(c) palm recopping and/or continued growth of untapped stems, with tapped stem recovering to produce new leaves.

Income to tappers was derived directly from the local value of palm wine, which is traditionally set by the Tribal Authority. The price of palm wine remained fixed at 10c per litre until September 1982, when the price rose to 20c per litre.

The _H. natalensis_ palmveld area was determined from the 1:100 000 scale vegetation map of the study area (Loxton et al., 1969) using a Tektronix Digitizer.

RESULTS

Allocation of tapping rights

Each homestead has "territories" around it which are there for the use of certain tappers of that homestead. New people who want to tap palm wine must first approach the headman. Then the headman or the tribal policeman indicates an area in the veld where there are no territories belonging to anyone else. A payment of R2,00 or 20 litres of palm wine is given to the induna when the area is allocated, and a further 20 litres during the course of tapping. The boundaries of these tapping areas are respected by other tappers. Any disputes are taken back to the tribal policemen or headman.

Tapping and palm wine yield

Palm clumps are selected and large stems within these clumps are prepared for tapping. The tapping method and equipment used in Maputaland (Figures 3 a,b,c,) have been described (Heard, 1949; Felgate, 1965, 1982; Moll, 1968). The mechanism of sap (phloem sap) production is discussed in detail by Tammes (1958) and Tammes et al., (1969).

Although one of the interviewed tappers was tapping 288 palms, which required a 9-hour day to trim and collect the palm wine, subsequent field observation and interviews showed this to be very unusual. The rest of the interviewed tappers were tapping 71.2 $\pm$ 42.3 stems per batch ($n = 17$ batches). The selected tapper exploited 69.4 $\pm$ 36.1 stems per batch ($n = 13$ batches) during the year. Data for the selected tapper was therefore assumed to be representative of tappers in the area.

Income (or yield) increases with a higher number of stems tapped. There was a reasonable linear relationship between palm wine yield and stem number ($p<0.025$; $r = 0.56$) for the measured data and a clear linear relationship ($p<0.0005$); $r = 0.97$) for the interview data, possibly indicating that the tappers have a similar idea of the maximum daily yield that can be expected per tree. Use of linear regression requires the assumptions that there were no seasonal effects on palm wine volumes collected by the single selected tapper and that there was no effect of time difference between measured and interview data sets. In the light of field observation and the quantitative measurement of daily palm wine yields, I feel that these are reasonable assumptions. Although there is a significant difference between the linear regressions ($t_{DIFF} = 3.58$) when yield is plotted against stem number (Figure 4), if these axes were inverted, there would be no significant difference ($t_{DIFF} = 0.342$) between the slopes of the measured and interview data. However, the inversion of the graph axes presupposes that a tapper's personal desired maximum yield may determine the number of trees he wishes to tap and

FIGURE 3. The tapping method used in the study area. A. Trimming the selected stump to initiate sap flow. The stick to the left of the tapper is used to whet the cutting knife. B. Palm leaf cover keeping rain, dust, sun and insects off the stem and collection container. C. Cut stem in the first week of tapping showing palm leaf gutter funnellilng sap into the clay collection container. D. Stem at the end of the tapping period (four weeks later) showing that extensive cutting that has removed the leaf bases.

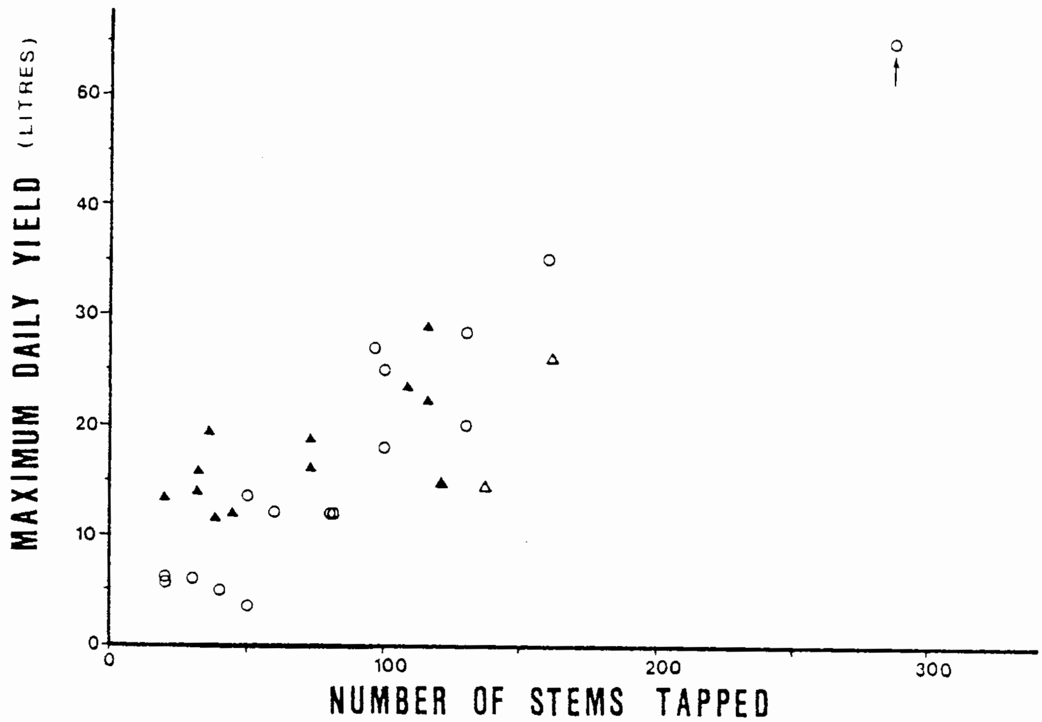
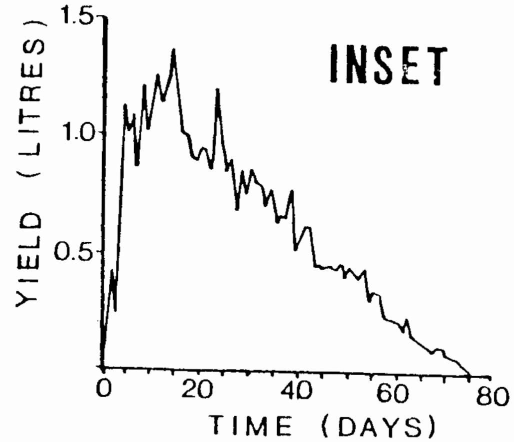


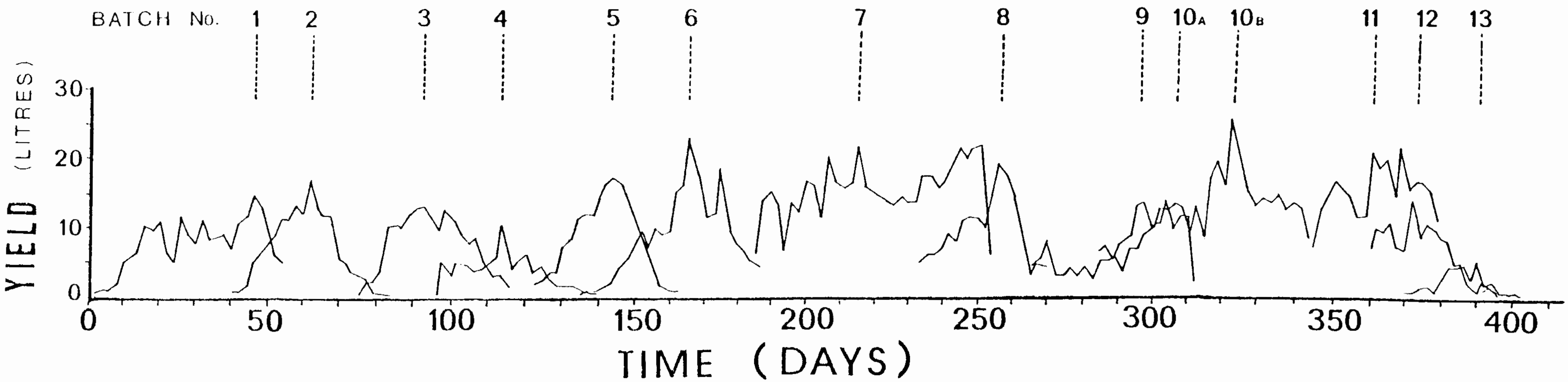
FIGURE 4. Estimated (○, n = 16) and measured (▲, n= 13) maximum daily palm wine yields plotted against number of stems tapped. Quantitative data has been separately plotted for <u>H.natalensis</u> (▲) and <u>P.reclinata</u> (△) palms. Estimated data includes both species.

the regression lines are not shown here.

For the first few days sap was left to flow from the palms and was not collected, as fermentation was initially slow. Over the tapping period the flow of sap from batches of both H. natalensis and P. reclinata palms increased to a peak and then declined over 43,9 $\pm$ 9,5 days (Figure 5). The volume of palm wine collected followed this basic trend but was subject to fluctuations. Yields were affected by the skill of the tapper, the frequency and efficiency of collections and trimming, rainfall and insect infestation. Although the selected tapper was assisted by his wife (a less skilled tapper) occasional absence due to ill-health or intoxication resulted in fluctuations in palm wine yield due to inefficient palm wine collection or irregular trimming. Tappers also discard sap diluted by rainfall as this affects palm wine quality. Infestation of tapped stumps by beetle larvae (Curculionidae : (Rhynchophorus phoenicus) and an unidentified Scarabaeid species) stops sap flow but was insignificant to total yield, only affecting 0.3% (3) of the 902 stems. As yields from the earlier batch of palms starts to decline new stems are prepared (Figure 5). This buffers out major fluctuations in total yield and/or income (Figure 7) as yields from the new batch are increasing when yields from the previous batch are decreasing.

FIGURE 5. Palm wine yields from individual batches of palms (1-13) tapped between November 1981 - November 1982, showing increase and drop in palm wine yields for each batch. Inset shows a similar trend in palm sap yields from <u>N.fructicans</u> (Gibbs, 1911a).





Most palm wine tappers live adjacent to the palm veld where subsistence crops can be grown. Temporary shelters (ama Gobela) are set up in the palmveld in tapping areas allocated to them by the local tribal policeman, or headman. When the large palms in the vicinity of the shelter have been tapped, a new shelter is set up within the tapping area.

During the year November 1981 - October 1982, 712 palms (902 stems) were tapped, producing 4 846 litres of palm wine (Table 1).

Economic value

Assuming a 2:1 split, and taking the price of 10c per litre set until August 1982, and 20c per litre from September 1982, it was possible to work out monthly and weekly income from palm wine sales (Figure 6 and Table 2). Monthly income to this selected tapper from palm wine tapping during the study period was R30 - R70,00 per month (R49,50 $\pm$ R21,00) (n = 11 months) (Table 2).

Transport to sale points (eziKhombozini) is done on foot. Plastic 25-litre containers (iziPakupaku) are commonly used (Figure 6) rather than traditional clay containers (iziMbiza) or glass bottles (amaGunklu) (20 litre), iziMphiselo (12 litre) or iziBhakela (5 litre) which were frequently used until the mid-1970's.

Table 1. The number of H.natalensis and P.reclinata palms tapped by a selected tapper during the year November 1981 - October 1982 showing stem number, tapping duration and yields.

Batch No.	No. palms	No. stems tapped	Tapping duration (days)	Total yield	Mean yield/ stem/day	Total yield /stem
1	100	121	54	390.2	0.06	3.22
2	66	73	44	298.1	0.09	4.08
3	38	38	43	299.2	0.18	7.9
4	43	45	44	142.7	0.07	3.2
5	66	73	41	306.5	0. 1	4.2
6	90	116	50	395.7	0.07	3.4
7	108	116	66	341.4	0.12	8.1
8	27	33	36	284.3	0.23	8.6
9	18	19	30	261.3	0.45	8.7
10a	23	76	±52	738.5		
10b	16	53	±36			
11	92	107	35	533.1	0.14	5.0
12	27	32	40	254.7	0.2	8.0
Total	714	902		4845.7		

10a and b = Phoenix reclinata
1 - 9, 11 and 12 = Hyphaene natalensis

TABLE 2

Total income earned from palm wine sales by a selected tapper, and income split tapper:seller on a traditional 2:1 basis, tapping ± 6 hours per day, 30 days per month. All income figures are derived from the daily measurements of palm wine yield converted to income on the basis of the set price/volume.

Month	Total Income R	Tapper's income R	Seller's income R
November 1981*	9.35*	-	-
December 1981	37.36	24.91	12.45
January 1982	44.67	29.78	14.89
February 1982	23.64	15.76	7.88
March 1982	44.16	29.44	14.72
April 1982	34.19	22.79	11.40
May 1982	44.66	29.77	14.89
June 1982	64.12	42.75	21.37
July 1982	23.97	15.98	7.99
August 1982	61.70	41.13	20.51
September 1982	79.12	52.74	26.38
October 1982	86.84	57.90	28.94
Estimated Annual Income	594.00	396.00	198.00
Estimated Monthly Income (n = 11 months)	49.50 ±21.00	33.00 ±14.00	16.49 ± 7.00

* = Not included in calculations. Considered unrepresentative as at the start of tapping/income from the previous batch was not available.

FIGURE 6. Typical palm wine transport from tapping shelter to sale point.

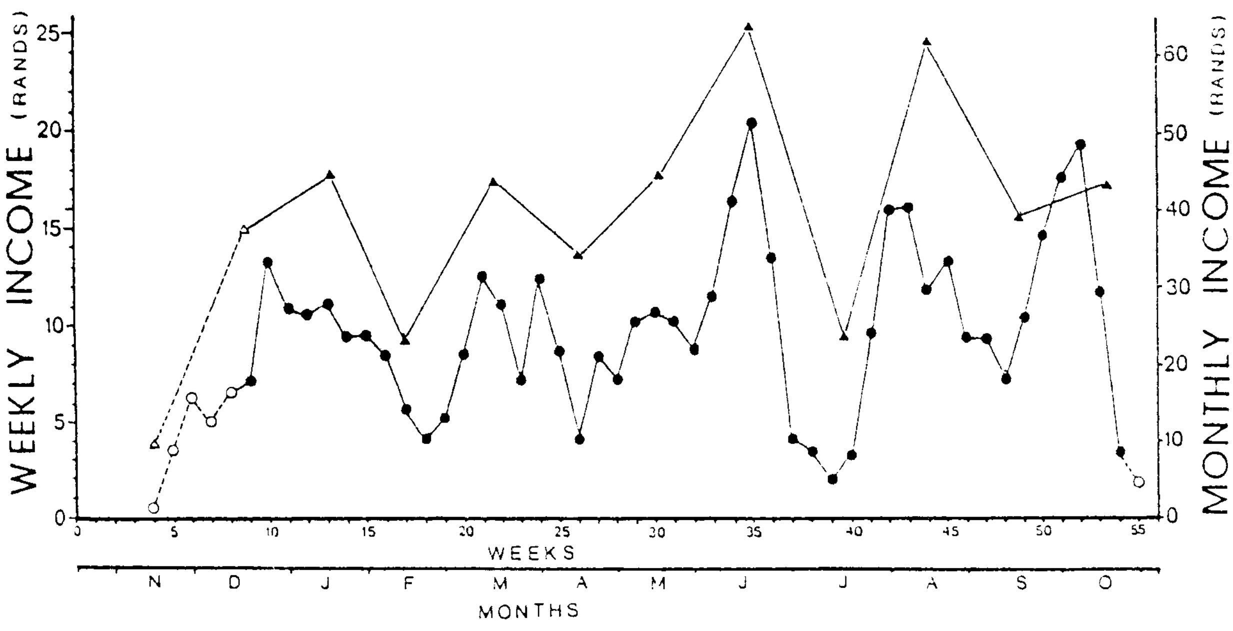


FIGURE 7. Total monthly (▲) and weekly (●) income to the selected tapper over a 12-month period.

There are an increasing number of women who now tap palms, but men never carry palm wine to sale points. Women employed to transport palm wine work in their fields in the early morning and then go to the tapping shelter to fetch the palm wine. Women are either employed by the tapper, or may be the tapper's wife, in which case the profit is kept within the family. Because of the type of transport and the container size, 25 litres was the maximum volume that was carried by most women.

If a tapper was collecting more than 25 litres per day, two sellers working on alternate days of the week were usually employed. Tappers obtaining less than 25 litres per day only had one seller, working on the main sale days (Monday, Wednesday, Friday).

SPECIES SELECTION

Three palm species, H. natalensis, P. reclinata and Raphia australis **Oberm. & Strey** occur in Maputaland. All are potential sources of palm wine. R. australis palms occur in a localised and relatively inaccessible area near the coast and are not tapped. P. reclinata and H. natalensis are both tapped, depending on their availability and, possibly, on seasonal selection.

P. reclinata is also tapped near the coast, where few

H. natalensis occur, but palm densities are not great enough to support large scale tapping. In the palmveld area H. natalensis is the most abundant palm species. Eighteen tappers interviewed allowed counts of their tapped palm stems to be done or were able to estimate the number of palms they were tapping. Other tappers were unable to estimate their tapped palms or were suspicious and refused to allow the field assistant to count their palms. Of an estimated 1 449 stems being tapped, 69.2% (1 003) were H. natalensis and 30.8% (446) were P. reclinata. The selected tapper tapped 712 palms (902 stems) during the year. Eighty-six per cent (773) of these stems were H. natalensis and 14% (129) were P. reclinata stems. The higher percentage of H. natalensis tapped reflects the greater abundance of that species is the selected tappers' area. The greater density of P.reclinata clumps in the eastern palmveld area accounts for the predominance of P. reclinata species estimated by interviewed tappers. Where both species occur, tappers claim to tap H. natalensis during summer, and both H. natalensis and P. reclinata or only P. reclinata during winter, as palm wine yield from P. reclinata was higher than H. natalensis during winter. This was not confirmed by quantitative data from the selected tapper. However this could have been due to the selection of larger, higher yielding H. natalensis during winter.

Stem selection

Due to the effects of fire and tapping in the past, both palm species occur in clumps. Tappers practise a type of rotational management. Large stems in these clumps were selected for tapping. Smaller stems which would yield less palm wine, were left to be tapped at a later stage. (Figure 8). In a sample of 125 tapped H. natalensis clumps (palms), 38,6% (386) of the stems were tapped, while 23,1% of the 555 stems in 39 P. reclinata clumps were tapped (Table 3).

Tapping damage

A sample of H. natalensis (188 stems on 165 plants) and P. reclinata (89 stems on 38 plants) were assessed to determine recovery from tapping damage (Table 4).

Both H. natalensis and P. reclinata stems died from tapping, but individual palm clumps were seldom killed.

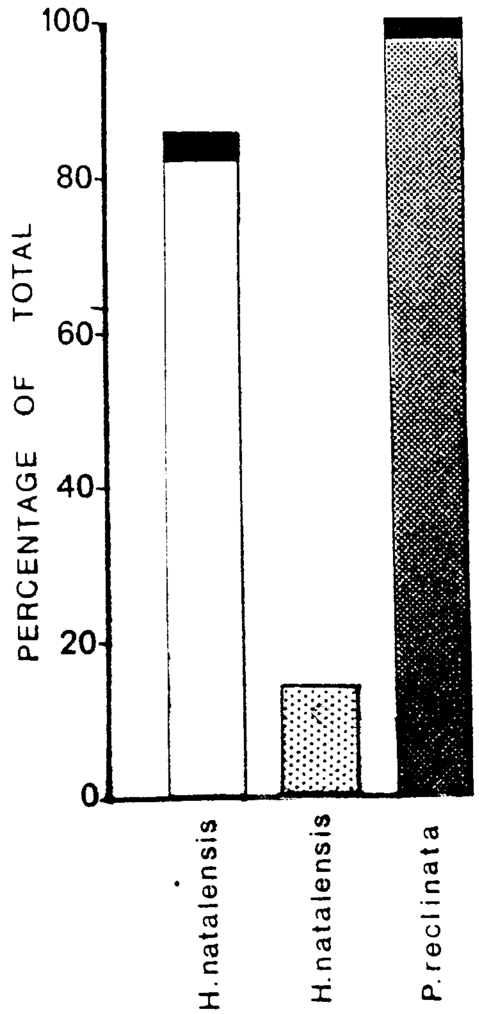
If tapping stops before the apical meristem is destroyed, the stems of H. natalensis (and possibly P. reclinata) recover and produce new leaves. However, the meristem is usually trimmed away until sap flow decreases to the stage where it is no longer worthwhile to collect the sap. No P. reclinata stems, and only 13,8% (26) of H. natalensis

TABLE 3. Selection of *Hyphaene natalensis* and *Phoenix reclinata* stems for tapping. Large stems selected for tapping are in the minority. The remaining smaller stems are left to grow until they reach a size large enough to warrant tapping.

CATEGORY	*Hyphaene natalensis*	*Phoenix reclinata*
Total number stems	386	555
% stems tapped	38.6% (149)	23.1% (128)
% stems untapped	61.4% (237)	76.9% (427)
(No. of clumps)	135	39

TABLE 4. Tapping damage to *H. natalensis* and *P. reclinata* stems tapped by a selected tapper. Palms were assessed for damage after the end of tapping.

SPECIES	Stem and palm dead	Tapped stem dead; palm re-coppicing	Tapped stem recovering
Hyphaene natalensis n = 188	7	155	26
Phoenix reclinata n = 89	2	87	0



= palm and stem/s dead

= tapped H.natalensis stem dead (palm recoppiced and/or continued growth of untapped stems)

= tapped P.reclinata stem dead (palm recoppiced and/or continued growth of untapped stems)

= tapped stem recovered and producing new leaves.

FIGURE 8. Assessment of palm wine damage. Plants were inspected ten months after tapping to determine the extent of damage to H. natalensis (n = 188 stems (165 plants)) and P. reclinata (n = 89 stems (38 plants)).

FIGURE 9. H.natalensis stem re-sprouting after less intensive tapping damage.

stems in the sample recovered from tapping (Figures 8 and 9). Apart from cases where the palm dies (Figure 8) untapped coppice stems rapidly recover from the burning that precedes tapping and are tapped at a later date.

DISCUSSION

The palm wine industry in Maputaland has developed due to the extent of the high palm density area, the market for palm wine and the low agricultural potential of the region which has necessitated reliance on the area's natural resources. Palm wine is also a resource that is available throughout the year.

Money coming to the people from the sale of palm wine is used for buying from the store, to pay school funds, or to pay herd-boys if cattle are owned. However, although palm wine tapping is an important form of income in the area, it is generally regarded as an income generating activity to tide a person over a bad period when no other work is available, since palm wine tapping only provides a subsistence wage. The only other option for this sector of the community, most of whom are illiterate with no knowledge of English, is employment as migrant-labour on farms (e.g. cane cutting) or in industry (e.g. mine labour), where take-home pay is often low and family contact infrequent.

The trade in palm wine from the tapper to the seller and seller to customer or secondary seller, is a chain of events which brings income to a wide spectrum of people

(Cunningham, in prep. a). Palm wine originally selling for 10c per litre was diluted approximately 50/50 with water and sold for 20c to 50c per litre. Felgate (1965) records 40c or 50c being paid for 4 gallons on the Mosi drainage zone and prices rising to 25c per gallon at Kosi or on the Pongolo floodplain (prices recorded 1964-1965). In other words, prices have increased approximately five-fold over the last 20 years.

Apart from economic aspects, palm wine is the most widely consumed alcoholic beverage in the area and has an important nutritional value (Heard, 1955; Van der Merwe et al., 1967; Nash and Bornmann, 1973; and analyses for this study). It is important that management of the palm wine resource on a sustained-yield basis is considered because of the economic and nutritional value.

Current level of exploitation and carrying capacity

This study determined the yield and income to an individual palm wine tapper established to be representative of other full-time tappers in the study area. This man tapped 712 palms (902 stems) producing 4 846 litres of palm wine. During the year November 1981 - October 1982, concurrent monitoring of palm wine sales determined that regional sales of undilute palm wine totalled nearly 980 000 litres (Cunningham, in prep.a). This would be collected by about 200 full-time tappers producing nearly 5 000 litres (i.e. 4 846 litres) per year.

Based on field observation of palm regrowth by marked palms tapped between October 1981 and April 1984, I would estimate that it takes 6-8 years for a new coppice shoot to reach a suitable size for tapping. This is longer than Felgate's (1965, 1982) figure of between 3-5 years, which is almost certainly an underestimate.

The average full-time tapper would therefore require 4 200-5 600 palms to support his tapping on a sustainable basis. *Hyphaene natalensis* is the main species used as a source of palm wine, representing 86% of stems tapped by the selected tapper and 69% of those by interviewed tappers. There are approximately 25 600 hectares of *Hyphaene* palmveld in the study area, of which 17 600 hectares are close enough to marketing points to suply the palm wine industry.

At an average density of 92.5 *H. natalensis* palms/hectares (Moll, 1972) there are approximately 2 370 000 palms in the entire study area and 1 630 000 palms currently under commercial exploitation. The carrying capacity of the area under commercial tapping would therefore be 300-400 full-time tappers. Over a ten-year period (1974-1983) the population density of the Mosi-Palm Zone has increased by 30%, from 8.8 people/kilometre to 12.6 people/kilometre. At the time of this study, there were an estimated 200 commercial tappers and at this rate of increase, carrying capacity would be reached in 2-4 years. However, the effects of road-building, drought and the economy have resulted in an escalation in the palm wine industry and will shorten this period.

If the assumptions made are correct then the H. natalensis resource base was slightly below maximum carrying capacity. The question is what will stop the increase in tapping pressure and eventual over-exploitation of the resource?

Although the land is communally owned, tapping rights given to individuals are respected by other tappers. The boundaries of tapping areas which are "demarcated" by indigenous trees; paths or characteristic patches of vegetation are kept to and if disputes occur, they are taken to the tribal court. The maintenance of traditional tapping boundaries, which are often kept within families, and the respect for the tapping rights of other individuals, are important limiting factors on the number of tappers in the palmveld.

Tribal price control, which ensures that this commodity is within reach of most of the community, is another major limiting factor on utilisation. Coupled with the small size and low yield of the palms, this limits income to tappers and removes a major incentive to tapping. This reduces the intensity of palm utilisation. Tapping is labour-intensive and tappers worked 6-8 hours per day for a low economic return. This makes tapping an option for people who cannot get employment elsewhere, or who tap palms on a seasonal basis in order to supplement income from other activities.

While these traditional controls on tapping are still maintained, socio-economic factors are changing rapidly with the shift from a subsistence to a consumer approach to tapping and the development of a road infrastructure in the area. Greater tapping pressure on the palmveld is evident from the escalation in the palm wine trade over the past fifty years. Stock numbers have also increased with veterinary control of disease and the sourveld is frequently burnt to improve grazing.

A high frequency or intensity of tapping or leaf removal (through the effects of fire or for weaving material) can both affect palm vigor. Changes in palm productivity after defoliation, whether due to infrequent burning or tapping, would be expected with the resultant depletion of carbohydrate reserves in the plants and are confirmed by studies on other species. Frequent defoliation through grazing or simulated clipping of dicotyledonous woody plants (Lay, 1965; Buwai and Trlica, 1977; McConnell and Smith, 1977) and grasses (Miller and Donart, 1981; Stout et al., 1980) have shown declines in productivity. Information on palm utilization supports this. For example Tuley (1965b) notes the poor state of *Elaies guineensis* growth where palms have been tapped annually for many years. Continued defoliation of *Hyphaene ventricosa* reduced both mean number of leaves per palm and their mean weight (Fanshawe, 1967; Cunningham and Milton, in prep.). A critical stage has not yet been reached in Maputaland. Selection of large stems from multi-stemmed palms reduces both the frequency and intensity of tapping. Frequent burning of the palmveld reduces the amount of combustible material. Although the green leaves of larger palms are usually only singed as they are above the normal level of the flames (field observation and Fanshawe, 1967), fires do burn most of the leaves of short palm coppice growth. Atlhough this coppice growth is stimulated by fire and frequent burning could result in a decrease in carbohydrate reserves from the smaller plants (Fanshawe, 1967). Decreasing economic and nutritional returns from the resource correspond to the smaller stem sizes and yields resulting from high intensity tapping. Overexploitation would reduce future options for the people of the area and would not benefit them in the long-term.

The aim for the palm wine industry should be sustained economic yield where carrying capacity is not exceeded. In theory the tapping method and the skill of the tapper can be controlled to achieve optimal palm size, yield or income to tappers. Knowledge of palm utilization in other developing countries provides valuable insight into possible appropriate options for management of the resource in the Maputaland area.

Tapping technique, tapping skill and palm size.

Four tapping techniques are used. Tapping either the:

(A) Apical Meristem;

(i) after the palm is felled (Palisot de Beauvois, 1806; Tuley, 1965b). This only provided sap for a few days from Raphia vinifera (Palisot de Beauvois, 1806) and is not only destructive, but inefficient.

(ii) Without felling the palm. Thin horizontal slices are trimmed from the young shoot and with careful tapping the meristem is not destroyed (Tuley, 1965a,b; Gibbs, 1911b).

or

(B) Axillary Meristem.

Both male (Tuley, 1965 a,b) or female inflorescences (Gibbs, 1911a; Hart, 1965) are tapped.

Damage to the palm varies with technique, ranging from the most destructive A(i) where the palm is felled, to merely decreasing fruit production (B). In all cases the shoots must be trimmed regularly to prevent healing of the wound and to ensure continued flow of sap.

Method A(ii) is the most commonly used technique in southern Africa. It is recorded from Namibia (Malan and Owen-Smith, 1974), Zimbabwe (Bonghey and Gray, 1960; Meredith, 1955), Botswana (Cunningham, unpublished) and in the study area (Felgate, 1965, 1982; Moll 1968, 1972). This method is destructive, but the extent of damage has been exaggerated. Wicht (1969), Palmer and Pitman (1972) and Malan and Owen-Smith (1975) state that tapping kills the palms. Certainly most stems die after tapping, but only 3.7% of <u>H. natalensis</u> and 2.3% of <u>P. reclinata</u> plants died after tapping and the rest readily recoppiced (Figure 8). The high percentage of stem die-off can be avoided by halting tapping before the apical meristem is totally destroyed (Figure 9). This would allow recovery of the tapped stems, a marked decrease in rotation time and an increase in carrying capacity of the area. Reduction of the tapping period by a week would only result in a loss of about R3,00 to R4,00 per batch, as yields will have already dropped to a low level, but would reduce stem replacement time by 2-3 years.

Large palms of other species produce more sap per unit time and can also be tapped longer (Gibbs, 1911a; Table 5). Field observation of the volume of palm wine collected from large <u>H. natalensis</u> palms in the study area supports these facts, which are well-known to tappers. In Maputaland most palms and yields are small and each palm is visited two to three times a day to trim the shoot and collect the sap. Tappers need to maximise their returns and to do this they have reached a compromise between two extremes. Firstly a high yield per tree (or stem) due to

Table 5. Summary of production, rotation time and tapping methods for eight palm species. *Hyphaene natalensis* palms were tapped for the lowest yields and economic returns.

SPECIES	n	Mean daily yield per plant (litres)	Total yield per plant (litres)	Estimated rotation time (years)	Mean yearly production (litres)	Tapping method	Source
Raphia hookeri	104			never 3 months usually 1 year^{-1}	118	inflorescence buds	Tuley (1965d)
Nipa fructicans	6	0.58	43.4	1 year	43.4	flower stalks	Gibbs (1911a)
Cocos nucifera[1]	100	1.38	41.4[2]	-	-	flower stalks	Gibbs (1911b)
Cocos nucifera[1]	5 785	0.65	-	1 year	432.6	flower stalks	Gibbs (1911b)
Corypha elata	1	20.45	2 699.6	25 - 30 years	90 - 108	flower stalks	Gibbs (1911b)
Arenga saccharifera	3	1.26		1 year		flower stalks	Gibbs (1911b)
Arenga saccharifera[3]	2		24.0	1 year		flower stalks	Molish (1898)[4] in Gibbs (1911b)
Hyphaene ventricosa	-	-	-	6 years	-	leaf shoots	Meredith (1948)
Hyphaene natalensis[5]	90	0.09	4.4	6 years	0.51	leaf shoots	this study
Hyphaene natalensis[6]	18	0.48	14.5	8 years	1.0	leaf shoots	this study

1 = Experiment done with tappers under ideal conditions

2 = Over a 31-day period from one inflorescence. Palms usually produce 10 inflorecence stalks annually and will produce 300 - 400 litres/year.

3 = Distillery data (yields to tappers under field conditions).

4 = Molisch (1898) sitzungsber. Akad. d. Wiss. math-nat. Klasse Wien 107:1256 in Gibbs (1911b).

5 = Lowest yield/stem (Batch no 6 : Table 1).

6 = Highest yield/stem (Batch no 9 : Table 1).

skilled cutting. This is the option possible where palms with older, larger stems dominate the population. The second option is to reduce the time spent tapping and trimming each stem. This is feasible where a high palm population density exists. Skill is required to take thin slices from the leaf-base. If too thick a slice is taken, the meristem is soon reached and yields decline. In order to take thin slices, cutting knives are kept razor-sharp by tappers and a stick is always carried as a base for whetting these knives (Figure 2a). Gibbs (1911b) found that palm wine production from Cocos nucifera increased by 112% with careful management and with Corypha elata sap yield could be regulated by the number of daily cuttings.

In contrast to the palm wine industries in the Phillipines and West Africa which are based on large, high yielding palms, tapping in my study area was based on small palms with low yields (Table 5).

The higher palm wine price in Nigeria still does not mask the higher income and yields to tappers. Depending on demand and distribution, Nigerian palm wine sells for 86c to R3,50 per gallon* (4.5 litres) (Okafor, 1980). The equivalent amount would sell for 45c (pure palm wine) to 90c (dilute palm wine) at 1980 prices in my study area. This is two to three times cheaper than in Nigeria. However, Nigerian tappers earned 39c to R3.98 per tree per day and only 16% (5) of tappers surveyed by Okafor (1980) earned less than the minimum daily wage of R3,45 per day. Based on average daily yields, palm wine tappers in Maputaland earn only 1,6 cents per tree per day.

* Cash values in Okafor (1980) converted from naira (N) to rands (R). R1,00 = N0.66

Therefore, to earn the amounts shown in Table 2, Zulu/Thonga tappers in my study area were tapping 70-80 palms two to three times per day to ensure continued sap flow. To do this, trimming not only has to be skilful, it has to be quick. A misplaced cut into the stem below the cut surface will halt flow. Thick slices will reduce total time of sap flow and with the small size of the palms, thin slices are crucial. Because of this, it is unlikely that Gibbs' (1911b) experience of reversing the trend of daily sap yield from a declining to an increasing rate by cutting thicker slices could be put into practice, even if it were known by tappers.

Economic yield to tappers could theoretically be improved by tapping stems on a quota basis, utilising the small stems in the clump and leaving a selected 1 - 2 stems in each clump to continue growing. Increase in the price of palm wine could compensate for the drop in palm wine yield. Reduced pressure on the large palm stems would result in an increase in the proportion of large, high yielding stems in the area. These are currently only found at dip-tanks and protected areas such as the Chief's homestead. Rotational tapping could then be based on fewer, larger palms, in a similar way to the West African palm wine industry.

If age/size class of palm stems shifted to the extent that there was a high proportion of mature, fruit-bearing palms in the population, then inflorescence tapping could be practised on an annual basis as _Hyphaene_ palms flower annually. Unfortunately neither rotational tapping based on large palms, nor inflorescence tapping are practical.

Price control by Chief Tembe ensures that most of the community can afford palm wine but coupled with the small size and low yield of the palms, price control makes palm-wine tapping an unattractive job option. Thus price control is a major limiting factor on palm utilization. If the price were increased, more people would turn to palm wine tapping as a source of revenue, utilising previously unallocated tapping areas. Allocated areas, only seasonally used at present, would be used throughout the year and pressure would increase on the palm resource.

To allow the shift towards a larger stem size class would also mean control of burning and tapping. This would be virtually impossible to implement, as the palmveld is a communally owned, multiple-use area and resistance to change would be encountered from other land users. Influential cattle owners and their herd-boys who burn the sourveld (to improve grazing to stop cattle wandering and to improve fruit yields) would be particularly difficult to convince about the merits of changing the burning regime.

Mismanagement will ultimately reduce land-use options for the palmveld. The increasing frequency of burning, current overstocking and the destructive palm tapping technique are all leading to this.

This research has shown how low individual profits actually are (Table 2). In contrast, the regional value of the palm wine "industry" is high (Cunningham, in prep.,a). The economic value of palm wine sales derived from the 17 300 to 28 000 hectares that are tapped was

R 157 732 during the year from November 1981 - October 1982. Excluding the other major economic uses of palmveld for grazing and weaving material, this is equivalent to R 4 - R 7 ha^{-1} year^{-1}. In comparison, Pinus elliottii afforestation in the adjacent coastal grassland would make a net loss of R24 ha^{-1} year^{-1} * when running at full potential. There are also ecological grounds for maintenance of the palmveld in a near-natural state rather than afforestation (Cunningham, in prep.c). Palm wine tapping therefore provides a strong economic argument for maintenance of the palmveld in a semi-natural state rather than for afforestation recommended by Loxton et al., (1969). The rights given to individuals to tap palms within "concession areas" is also an important key to palm leaf resource management (Cunningham, in prep.b) as most indigenous plants are considered to be common property resources in this communally owned area. Primarily for these reasons, sustainable use of the palm wine resource is considered to be a justifiable aim. The problem is how to achieve it.

Management recommendations

In theory, there is a broad spectrum of management choices. At one extreme, tappers can be tapping fewer higher yielding palms for a higher economic return. At the other, they can continue to tap a large number of palms with a destructive method and without control of fire or improvement to tapping techniques, face diminishing returns.

* KwaZulu Department of Agriculture and Forestry
Private Bag X05
ULUNDI 3838

Although the primary objective of maintenance of the palm wine "industry" is sustainable use of the resource base, attaining this is difficult and complex. The problems of common property resource management are well known (Hardin and Baden, 1977). So are the constraints on conservation bodies through lack of adequate man-power, money and local support from rural people. What is certain is that attaining this objective will remain an open question until there is economic and political support to provide alternative work opportunities and steps are taken to reduce population growth rates. Also a certainty is that outside fenced conservation areas, all management is directly dependent on the support of local people. Without their support, management cannot take place. There should be two facets to palmveld management, one at the local level through the tribal authority, and the other at a broader governmental level to prevent large-scale development which would affect current land-use.

Local level

1. A change to the currently used tapping technique should be encouraged. Trimming should be halted before the apical meristem is destroyed. This would allow recovery of tapped stems and more rapid attainment of the stem size selected for tapping. Swifter regrowth after tapping would allow for a shift to larger stem (and palm) sizes

within tapping areas at present rates of exploitation or, at worst, an increase in the palm wine tapper carrying capacity of small "concession areas".

Reduction of the tapping period by a week to prevent apical meristem destruction would result in a short-term loss of R1 to R2 per month for the average batch of 70 palms but would reduce stem replacement time by two to three years.

2. Traditional price control should continue to maintain economic returns to tappers at a subsistence level. Increase in the price would ultimately mean over-exploitation of the resource and an even lower income.

3. Income to tappers should rather be improved by providing a market for palm-leaf weaving material which is currently left to rot after palms are prepared for tapping. The constraints on this are covered in Cunningham (in prep.b).

4. No distillation of palm wine should be allowed. This is not currently practised in the area but is recorded elsewhere (Meredith, 1948; Gibbs, 1911a,b,).

5. Mature palms at dip-tanks and windmills should not be tapped. They should rather be retained as a source of seed for planting in other areas. In the past, these palms were not tapped, but recently this has not been the case.

Departmental level

1. Palm wine tapping should be allowed to continue. With the abundance of H.natalensis and P.reclinata and their resilience to tapping, there is potential for sustainable use of the resource.

2. Tapping of R.australis palms should not be permitted.

3. The large-scale afforestation proposed for the palmveld should not be implemented. The palmveld should rather be maintained multiple-use area (particularly for cattle grazing lands and palm resource use) (see Cunningham, in prep.a) and as a buffer zone as proposed by Tinley and van Riet (1981).

4. Legal recognition should be given to palm wine tappers and sellers. Palm wine has a low alcohol

content (2-4%) and its sale provides an important source of income to rural people (see Note 1).

5. In view of their low income, neither palm wine sellers nor tappers should be burdened with licensing fees or other charges.

6. Traditional controls of palm wine tapping through the tribal policemen and headmen should not be disturbed.

7. The canning or bottling of palm wine suggested as a possible option by Tinley and van Riet (1981) for export out the area is not recommended because of the high local demand for palm wine, its nutritional value locally and the critical role of price control in reducing overexploitation of the resource.

Note 1

Hughes (1981) has already recommended that "the Department of Justice should be requested to investigate the possibility of legalising the brewing of certain types of traditional beverages, and the abolishment of licensing and other requirements restricting petty trade; and the Department of Interior should be requested to investigate the possibility of issuing licences for the use of covered light delivery vehicles to carry passengers in the rural areas.

CONCLUSION

The 17 300 hectares of H.natalensis palmveld in the study area were estimated to currently support 200 fulltime tappers.

Although R157 732 per annum is generated by the palm wine industry, individual profits are small. In contrast to the West African palm wine industry which is based on tall, high-yielding palms, the small size and yield of H.natalensis and P.reclinata palms in the study area restricts palm wine tapping to a labour-intensive activity providing a subsistence income. Growth of new coppice shoots is slow, but price control, the labour-intensive nature of palm wine tapping, and the allocation of individually controlled areas limit utilisation. In theory, palm- wine yields could be increased through controlled burning and tapping pressure which would allow a shift towards larger size classes in the palm population, which could then form the basis for rotational use of fewer larger and higher yielding palms. A high percentage of these would recover if trimming stopped before the meristem is destroyed. At present this is not possible due to the complications of communal land ownership and multiple-use of the palmveld area, but more practical management options are possible within these constraints.

ACKNOWLEDGEMENTS

The interviews with palm wine tappers would not have been achieved without the insight, local credibility and out-going personality of B.R. Gwala. J. Ncube, A. Ntombela, I. Gumede, S.J. Khumalo, Rev. Khumalo, B. Ntuli and M. Ntshembeni all gave valuable help during the survey which would not have been possible without permission from the Director, KwaZulu Bureau of Natural Resources. The funding from the Human Needs, Resources and the Environment Section of the C.S.I.R. whilst writing up the project is acknowledged. Advice on statistical analysis from Dr. T. Dunne and comments on the manuscript from P. Norton and Prof. E.J. Moll are appreciated.

LITERATURE CITED

Balick, M.J. 1979. Economic botany of the Guahibo. I. Palmae. Econ. Bot. 33(4) : 361-376.

Beaumont, P.B. 1980. On the age of Border Cave hominids 1-5. Paleont. afr. 23 : 21-23.

Beaumont, P.B., de Villiers, H. and Vogel J.C. 1978. Modern man in sub-Saharah Africa prior to 49000 B.P.: A review and evaluation with particular reference to Border Cave. S. Afr. J. Sci. 74 : 409-419.

Boughey, A.S. and Gray, W.D. 1960. The malala wine industries of southern Rhodesia. Proceedings of the first Federal Science Congress, Salisbury. pp. 173-180.

Buwai, M. and M.J. Trlica. 1977. Multiple defoliation effects on herbage yield, vigor and total non-structural carbohydrates of five range species. J. Range Manage. 30 : 164-171.

Cunningham, A.B. in prep.a. Palm wine tapping in Maputaland, South Africa : Contribution to the regional rural economy.

Cunningham, A.B. in prep.b. Commercial harvesting of *Phragmites australis* reeds in a low agricultural potential area.

Cunningham, A.B. and S.J. Milton in prep. Effects of the basket weaving on the mokola palm (Hyphaene ventricosa [Kirk]. Furtado) and on dye plants in N.W. Botswana.

Fanshawe, D.B. 1967. The vegetable ivory palm - Hyphaene ventricosa Kirk. - its ecology, silviculture and utilization. Kirkia 6 : 105-116.

Felgate, W.S. 1965. An ecological study of the Tembe-Thonga people. Unpublished report on research work. Edited by E.J. Krige. 167 pp.

Felgate, W.S. 1982. The Tembe-Thonga of Natal and Mozambique : an ecological approach. Department of African Studies, University of Natal. Occasional publications, No. 1.

Gibbs, H.D. 1911a. The alcohol industry of the Phillipine islands. Part I. Phillip. J. Sci. 6 : 99-145.

Gibbs, H.D. 1911b. The alcohol industry of the Phillipine islands. Phillip. J. Sci. 6 : 147-206.

Hardin, G.J. and J. Baden. 1977. Managing the Commons. W.H. Freeman, San Francisco.

Heard, C.R.C. 1955. Palm wine in human nutrition. Proc. Nutr. Soc. 14 : xi-xii.

Hughes, R.D. 1981. The extent and characteristics of non-agricultural activities in the rural areas of KwaZulu. Unpublished report, KwaZulu Development Corporation, 98 pp.

Junod, H.A. 1927. The Life of a South African Tribe. Reprint by University Books Inc., New York, 1962.

Lay, D.W. 1965. Effects of periodic clipping on yield of some common browse species. J. Range Manage. 18 : 181-184.

Loxton, Hunting and Associates. 1969. Development plans for Maputaland. Unpublished map series, 1:100 000. Department of Bantu Administration and Development.

Malan J.S. and G.L. Owen-Smith. 1974. The ethno-botany of Kaokoland. Cimebasia (B) 2 : 131-178.

McConnell, B.R. and J.G. Smith. 1977. Influence of grazing in bitterbush. J. Range Manage. 30 : 91-93.

Meredith, C.C. 1948. Vegetable Ivory Palm - notes on the collection of the sap of the vegetable ivory palm (*Hyphaene ventricosa*) and the manufacture of palm wine spirit. Rhod. Agric. J. 45 : 414-417.

Miller, R.F. and G.B. Donart. 1981. Response of Muhlenbergia porteri Scribn. to season of defoliation. J. Range Manage. 34 : 91-94.

Moll, E.J. 1968. Hyphaene crinita. Natal Wildlife 9 : 18-19.

Moll, E.J. 1972. The distribution, abundance and utilization of the lala palm, Hyphaene natalensis in Tongaland, Natal. Bothalia 10 : 627-636.

Nash, L.T. and C.H. Bornmann. 1973. Constituents of iLala wine. S. Afr. J. Sci. 69 : 89-90.

Okafor, J.C. 1980. Edible indigenous woody plants in the rural economy of the Nigerian Forest Zone. Forest Ecol. Manage. 3 : 45-55.

Palisot de Beauvois, A.M.F.J. 1806. Flore d'Oware et de Benin. 1 : 77-78 quoted in Russell, T.A. (1965). The Raphia palms of West Africa. Kew Bull. 19 : 173-196.

Palmer, E. and N. Pitman. 1972. Trees of southern Africa, Vol. I. A.A. Balkema, Cape Town.

Stout, D.G., A. McLean, B. Brooke and J. Hall. 1980. Influence of simulated grazing (clipping) on pinegrass growth. J. Range Manage. 33 : 286-291.

Tammes, P.M.L. 1958. Micro- and macro-nutrients in sieve-tube sap of palms. Acta Bot. Neerl. 7 : 233-234.

Tinley and van Riet 1981.

Tuley, P. 1965a. How to tap a Raphia palm. The Nigerian Field. 30(3) : 120-132.

Tuley, P. 1965b. How to tap an oil palm. The Nigerian Field. 30(1) : 28-37.

Tuley, P. 1965c. Studies on production of wine for the oil palm. J. Nigerian Institute for Oil Palm Research, Benin. 4(15) : 283-289.

Tuley, P. 1965d. The production of Raphia wine in Nigeria. Expl. Agric. 1 : 141-144.

van der Merwe, A. le R., I.M. Burger and A.S. Wehmeyer. 1967. Suid-Afrikaanse veldkosse : I. Makatini-vlakte, Noord Natal. Nasionale Voedingsnavorsings instituut. Unpublished report, CSIR.

Wicht, H. 1969. The indigenous palms of southern Africa. Howard Timmins, Cape Town.

Williamson, J. 1975. Useful plants of Malawi. University of Malawi. (2nd edition).

SECTIONS D, E & F

HUT BUILDING MATERIALS : ECONOMIC VALUE AND USE

In the Eastern Conservancy, as already intimated, there are about 356 341 acres of Demarcated and 97 574 acres of Undemarcated Crown Forests. In the year 1888 an effective Forest Act was passed, providing for the due conservation and systematic exploitation of Crown Forests. This did much to strengthen the hands of the Forest Department. Until then the forests of the Cape Colony were being maltreated to almost the same extent as the Natal and Zululand forests are to-day. The Act contains a schedule of 63 species of reserved trees, which natives and others are debarred from cutting for wattles or fuel.

Before the advent of the Forest Department, wood-cutters, in what is now the Eastern Conservancy, on obtaining a licence wandered through the forests and felled trees according to their fancy; if these did not answer their purpose they felled others. But what is worse than this, natives and others were permitted to cut and take countless thousands of sapling timber trees to use as wattles for the construction of their huts. Of course, the cutting away of this natural re-growth, in course of time, could only have had one result. To the forests it meant annihilation.

Storr-Lister (1902)

Building materials obviously play an important part in any consideration of housing for low to middle-income people in developing areas. The approach to this enormous and complex subject depends upon the objective to be attained. The point of view adopted here is that indigenous materials either now or potentially available must be employed to the fullest possible extent in order to keep costs down, avoid draining limited foreign exchange, and provide employment locally.

Deitz (1979)

COMMERCIAL HARVESTING OF PHRAGMITES AUSTRALIS REEDS IN A LOW AGRICULTURAL POTENTIAL AREA

A.B. CUNNINGHAM [1]

ABSTRACT

Phragmites australis reeds dominate an extensive area of the northern Mosi drainage, a narrow wetland area of the Maputaland coastal plain bordering on the Tembe Elephant Reserve, South Africa. While developers commonly consider wetlands as wastelands, in this area they are a productive resource-base for hut-building, craftwork and thatching materials. Like other African rural areas, the growing population is undergoing rapid cultural, economic and technological change. With improved roads and transport, trade in reeds for hut-building has increased. Daily monitoring of reed sales over a fifteen-month period showed the economic importance of the reeds, and their distribution to other areas. It also gives perspective on the need for the aspirations of local people to be taken into account in areas set aside for conservation.

INTRODUCTION

Phragmites australis (Cav.) Trin. ex. Steudel is a reed species with worldwide distribution. Commercial reed cutting for building material is common in Europe (Zonderwijk, 1962; Haslam, 1968; Veber, 1978) and extensive work has been done on the production ecology of *P.australis* in temperate areas (Haslam, 1968, 1970, 1972; Dykyjova and Hradecka, 1976; van der Toorn and Mook, 1982) including

1 Department of Botany, University of Cape Town, Rondebosch, 7700

studies on the effects of mechanical harvesting (van der Toorn, 1979; Ingram et al., 1980) and on birds inhabiting reed beds (Mc Millan, 1979).

Reeds are also an important low-cost building material in Africa, and use is widespread (Jacot-Guillarmod, 1971; Guedes, 1971; Liengme, 1983). In contrast to Europe, commercial sale of reeds is informal. Reed bundles prepared for sale are inconspiciously stacked against trees at cross-roads or a villages adjacent to wetland areas. Reed harvesting, which is only done by hand, is equally unobtrusive. As a result of this and the logistic difficulties in monitoring, there is a paucity of information on human use of Africa wetlands.

Quantitative data is limited to a recent study on Phragmites (P. australis and P. mauritianus **Kunth.**) removal by Zulu women from the Fuyeni reedbed, Natal, South Africa (McDonald and Schneebeli, 1981; Frankland, 1982). No information is available on the commercial value of reed harvesting to rural people in Africa and Thompson (1976) comments that "... natural swamps do not contribute the visible economic effort" in African wetlands.

The northern Mosi drainage in the Ingwavuma district, South Africa, is a narrow wetland dominated by P. australis (Figures 1 and 3). In the past, low population densities have limited the extent of reed cutting, but recent improvements to the road infrastructure have opened up the area to an external market for reeds.

Primarily because of its proximity to unique tropical dry forest, this wetland had been considered for inclusion into a reserve (Bruton, 1980, Tinley and van Riet, 1981). In a management plan for this area, Klingelhoeffer (1982) recommended that local people should be allowed to cut reeds. However, nothing was known of the extent of reed exploitation or whether it was for subsistence or commercial purposes. The aim of this study was to determine the extent of reed utilization and the regional value of the resource to rural people in relation to management and development plans for the area. Daily monitoring of reeds sales over a 15 month period, from May 1982 - July 1983 provided baseline data on the income generated locally through reed sales and the regional distribution of reeds sold.

The result of this data and the implications for conservation management are discussed in the following paper.

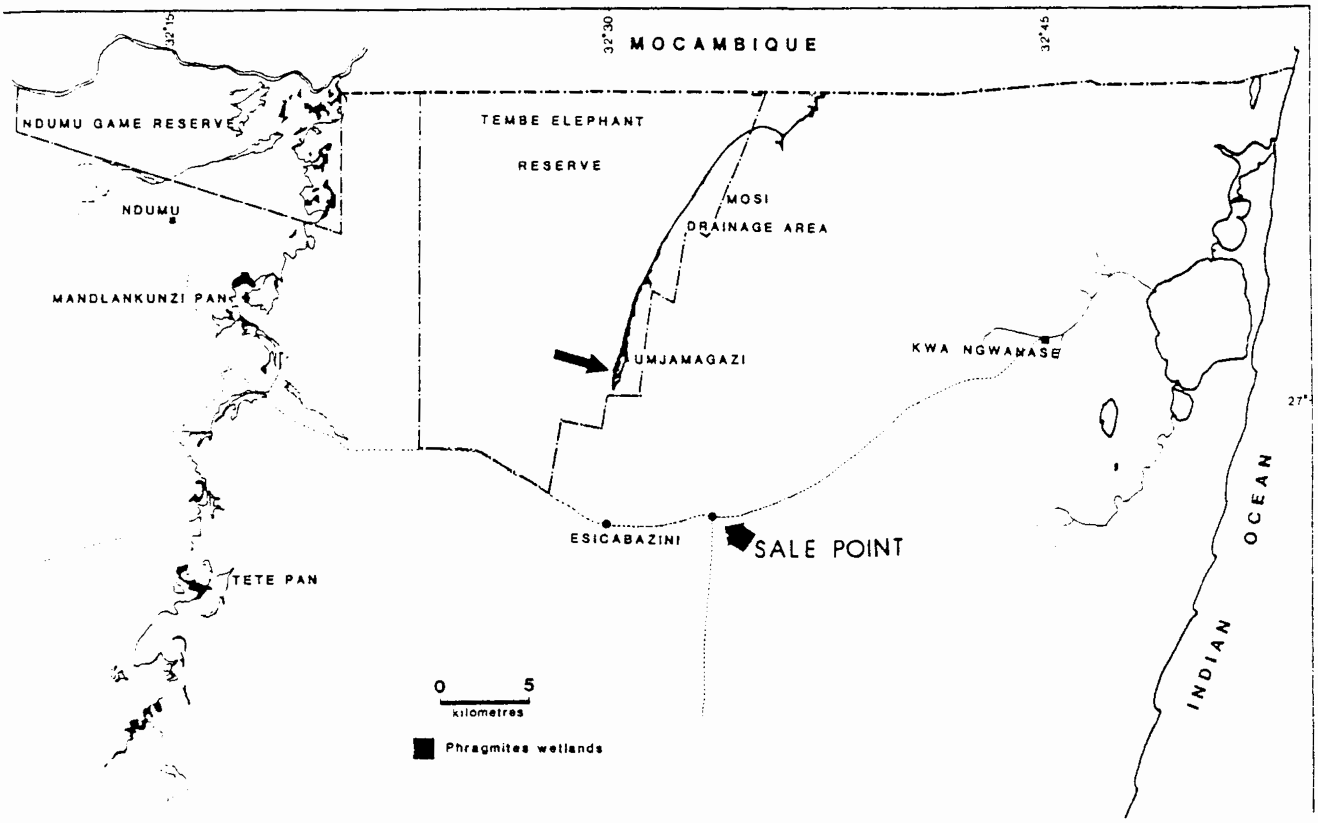


Figure 1 Map of the study area showing game reserves and major Phragmites wetlands. The alternative commercial cutting areas at Mandlankunzi and Tete pans lie just outside the study area. Sales were monitored at Phelendaba, the sale point indicated by the arrow. Phragmites wetlands on the Pongolo/floodplain are redrawn from Furness and Breen (1980).

Figure 2 Bundles of P.australis reeds stacked against a tree and ready for sale at Phelendaba.

METHODS

Permission to do a project investigating the resource value of indigenous plants to rural people on the Maputaland coastal plain was obtained from the Tembe Tribal Council in July 1980. The first phase of fieldwork involved recording Zulu and Thonga names for indigenous plant resources,and gaining the acceptance and confidence of people who would be able to help with the project. During this phase the extent of use of different materials and species used for hut-building was determined for different ecological zones (Cunningham, in prep. a).

Reeds are sold for hut-building at Phelendaba (Figures 1 and 2), a major cross-road which has developed into an economic growth point with a store and as an important site for the sale of palm-wine (Cunningham in prep. b) and cash crops. For a 15-month period, until the end of July 1983, the quantity and destination of reed bundles sold was recorded on a daily basis. On occasions when the enumerator was away, records were kept by a local resident. 97% of sale days were recorded. The remaining 3% were calculated from the mean daily sale figure during that particular week.

Reed bundles were weighed to the nearest 200 g with a 100 kg spring-scale. Mean bundle weight $\pm$ standard error and the set price per bundle (R2,00) enabled calculation

Figure 3 The *P.australis* wetland on the Mosi drainage line showing patches opened out by cutting (June 1983) and more permanent clearing of the reeds at a cattle crossing where *Typha latifolius* encroachment has taken place.

of the quantity and economic value of reeds sold. The area of reeds suitable for cutting and the total extent of P. australis communities was mapped in the field using 1 : 10 000 orthophotos (1979 series). The mapped areas were then measured using a Tektronix Digitizer.

RESULTS

The resource base for the reed cutting "industry" is the 296 hectare Mosi drainage area. This is the largest Phragmites wetland in the Ingwavuma district and the only site of commercial reed harvesting in my study area (Figure 1).

Commercial reed sales represent a significant income generating activity within the regional economy that has grown out of local initiative and is based on locally available recources. In the year May 1982 - April 1983, 19 106 bundles were sold at R2,00 per bundle (Table 1) and 19 695 bundles valued at R39 390 were sold during the 15-month monitoring period (Figure 5). With a mean bundle weight of 13,6 (SE $\pm$ 3.2) kg (n = 110) yearly sales represents 260 (SE $\pm$ 60) metric tons of leaf-stripped reeds sold, generating R38 200 within the rural economy.

Most subsistence cutting for local hut-building, takes place near the Mosi border post and between eSicabazini and umJamagazi (Figure 1) where population densities are

Table 1 The number and distribution of reed bundles sold from Phelendaba during the 15 month period (May 1982 - July 1983). Estimated monthly totals are shown in addition to the total number of recorded sales.

AREA TO WHICH REEDS TRANSPORTED	MONTHS M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	AREA TOTA
KWA-NGWANASE	564	392	622	462	316	574	430	295	168	358	320	172	247	158	189	5267
ZANGCMENI	151	188	150	141	63	199	254	160	48	103	30	68			34	1589
THENGANE	104	7		34	89	136	23	78	171	100	[illegible]	10		17	27	864
MFIHLWENI								25	35	50						110
PHELENDABA	248	235	387	229	111	267	191									1668
ESICABAZINI		5		16		49	14	13		10		10		12	30	159
SIHANGWANA	5		4		20		19	67	25							140
PHONGOLO	107	103	33	99	101	130	179	41								793
MOZI								10	25							35
THANDIZWE								30	116	40	54	20		4		264
NSUKUMBILI							5									5
NDUMO								14		15		105			25	159
KWA-ZIBI		16					92			20	85	35	20	24	20	312
KWA-SONTO	37	138	208	194	94	273	414	151	53	15	35	49		40	15	1716
NGUTSHANA					18	99	169	99								385
NDLONDLWENI	559	225	165	319	130	182	295	250	155	202	257	143	5	71	45	3003
MSELENI				15	6	13		38	66	56	25		7			226
TSHONGWE							7	110	215	100	135	60				627
MBAZWANA	153						80	42	20	20	57					372
MANZENGWENYA							41									41
MKUZE									70	60						130
VELABUSHA			14			32	10		109	43	87	30	20			345
INGWAVUMA	181		42	14				31	65				90	35	20	478
PHONDWENI		5						41	11	20	95			25		197
UBOMBO			91										22			113
KWA-MLAMULO			21													21
KWA-HLABEZIMHLOPHE			12		6	45										63
EZIMBUZINI				19												19
KWA-PHAHLA				16												16
MABIBI					10											10
SPACE CONSTRUCTION					5	3			21	23	78	15	5	5		155
KWA-NONDWAYIZA							3							5	5	13
MA KWAKWA													33			33
ZAMAZAMA							19			12	13					44
ENGOZINI							78			41	60	10				189
EMPANGENI										10						10
NKATHWINI											10					10
KWAMTSHIVA															5	5
MANQAKULANA											20					20
KWA-MAZAMBANE											54	15				69
MFEKANE												5				5
GAZINI												15				15
RECORDED SALES	2109	1314	1749	1558	969	2002	2323	1495	1373	1298	1483	762	449	396	415	19695
ESTIMATED TOTAL	2109	1369	1749	1558	969	2002	2743	1495	1428	1357	1540	762	449	396	415	

higher. Most commercial cutting takes place in the southern third of the wetland because it is closer to the marketing points (Figure 1).

Reed harvesting is a labour intensive process, practised by both men and women. Using bush knives, mature reed stems are cut as low down as possible and then stacked next to the cut area. The stems are stripped of leaves, and the inflorescences are cut off. Bundles of reeds, bound with Hyphaene natalensis leaves are either stock-piled adjacent to the wetland or taken directly to homesteads.

From discussions with the Zulu field assistants monitoring palm-wine and reed sales and with one of the women supervising sales it was estimated that at any one time there were 20 - 30 women supplying reeds to the sale point.

Harvesting season and regional sales

Reed-cutting usually takes place in the winter months, from April to September after the flowering period when reed stems are mature. The "standing stock" from the previous years growth may also be cut.

In contrast to the peak reed harvesting season, sales to many of the economic growth points sales peaked in spring/summer (October - January), particularly in response to demand from KwaSonto, Zangomeni, Mseleni, Tshongwe and

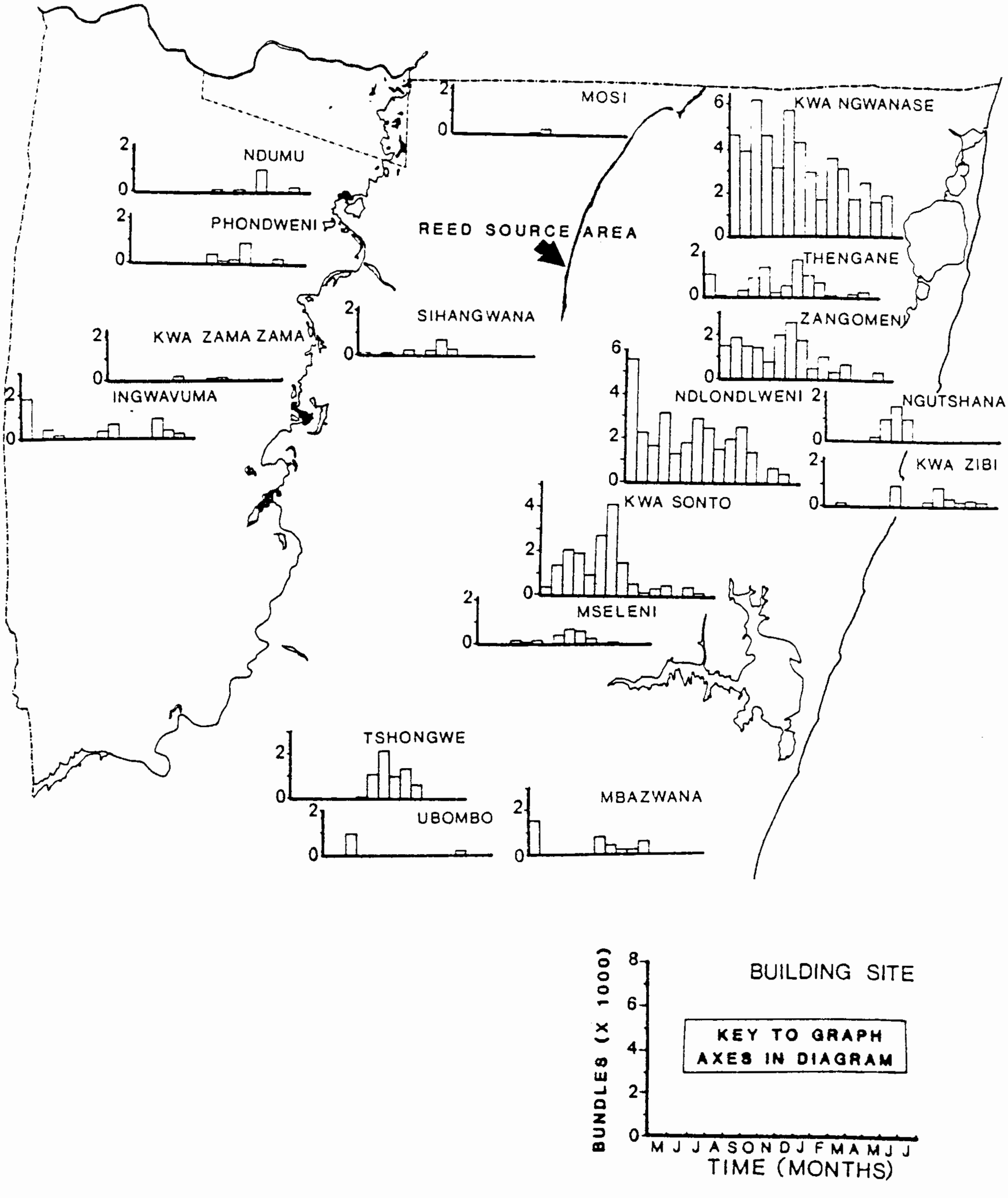


Figure 4 Post-sales distribution of reeds sold from Phelendaba to areas where most building was taking place in Maputaland (May 1982 - July 1983). Regional demand is mainly from the eastern side of the area. Alternative sources of commercially cut reeds at the Tete and Mandlankunzi pans on the Pongolo floodplain are presumably supplying builders on the western side of the Ingwavuma district. Areas to which fewer reed bundles were transported (shown in Table 1) are not figured here.

Sihangwana (Figure 4). Major growth points (KwaNgwanase, Ndumu, Thengane and Ndlondlweni) did not show such a distinct seasonal peak.

Most bundles (93,1% (18 935 bundles)) were sold to economic growth points on the eastern side of the Ingwavuma district. Only 9% (1 828 bundles) were sold locally (excluding sales to a road construction company at the sale point). Sales to large villages on the western side of the district (e.g. Ndumu and Ingwavuma) were low. Huts in these areas are either built from locally available plant resources or from reeds sold from Phragmites wetlands on the Pongolo floodplain.

Individual income from reed sales

Income from reed sales is split between women transporting reeds to the sale point and two women resident at the Phelendaba sale point who supervised and collected the money from reeds sales, after the reed cutters/transporters have returned home. Each sale supervisor was paid 20c per bundle sold. Due to the intermittent and informal nature of reed cutting and supply to the sale point, it was not possible to determine exactly how many reed-cutters were supplying the sale point per unit time or to determine individual income. People in the area are suspicious of questions, particularly those relating to economically important commodities due to fears about additional taxes.

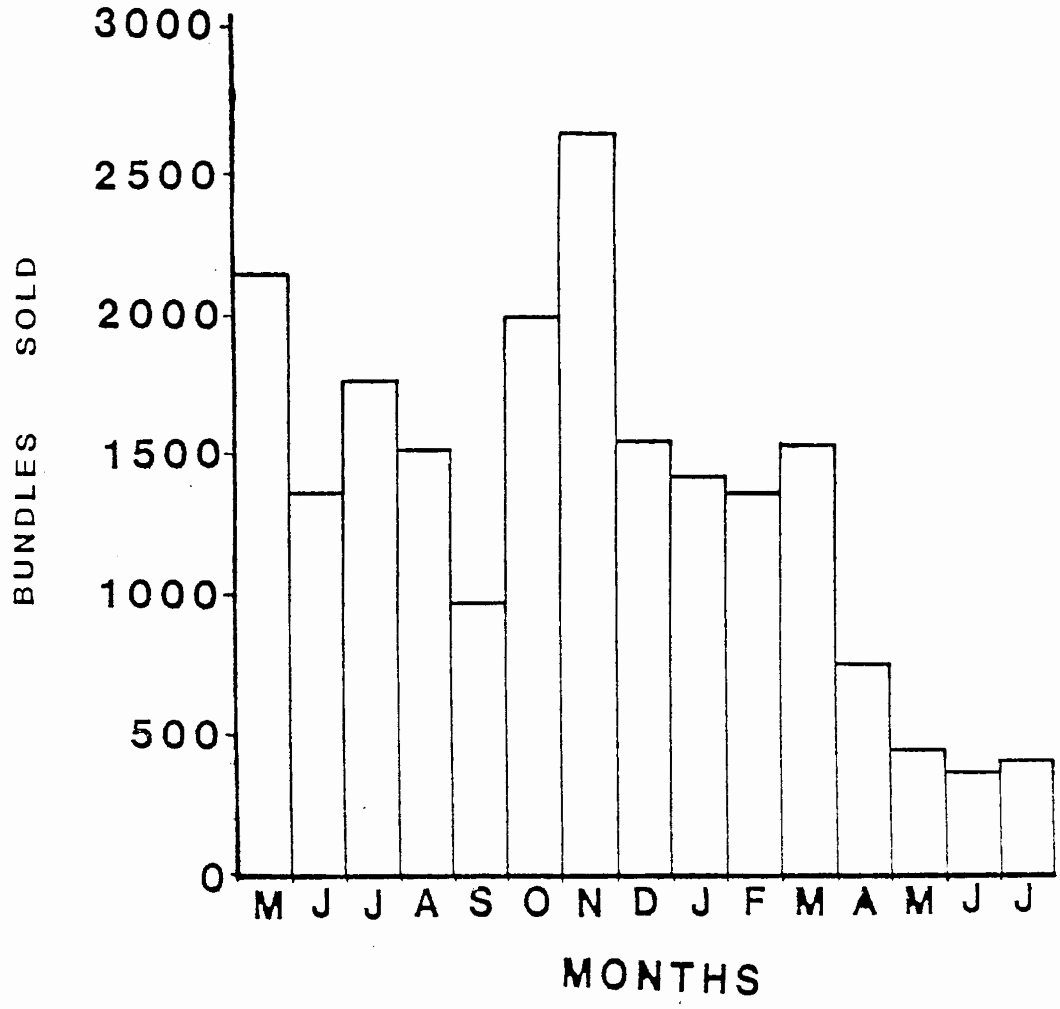


Figure 5 Reed (*Phragmites australis*) sales from Phelendaba (the only reed sale point in the study area) over a 15 month period (May 1982 - July 1983) showing summer sales peak rainy season when men (hut builders and migrant labourers) return home over the Christmas period.

Rather than jeopardise the primary aim of the study, which was to determine the regional economic value of the reed resource and the total quantity of reeds cut from the wetland, questions on individual reed cutters were kept to a minimum. Assuming that women regularly supplied reeds and 60 women supplied the sale point for four months per year, full-time suppliers would have earned about R938 per year (R78 per month) and part-time suppliers approximately R313 per year.

DISCUSSION

While wetlands may be considered "wastelands" by urban oriented developers, the *P. australis* wetlands along the Mosi drainage are neither wastelands nor are they a purely locally used resource. Reeds are a dominant wall-building material on the coastal plain (Cunningham, in prep. c;). The alternative wall-building material is hardwood laths. These are woven between upright poles into a rigid framework. Lath weaving is time-consuming. Collection and construction takes at least twice as long as wall-building with reeds. Reeds are light yet durable and enable quick, easy construction. There are no locally available alternatives to reeds with these qualities.

Commercial reed cutting areas also occur at the Tete and Mandlankunzi pans on the Pongolo floodplain which were outside the study area (Figure 1). The total extent of the *Phragmites* community of this floodplain is approximately 234 hectares, about 65 percent being *P. australis*, mainly in the Ndumu Game Reserve (Furness and Breen, 1980; Heeg and Breen, 1982).

In contrast to the *Phragmites* communities lying outside Ndumu Game Reserve on the Pongolo floodplain, where stand-height, area and cover-abundance has been reduced by intensive cutting and burning (Furness and Breen, 1980), the low population density around the Mosi drainage has kept these influences and the effects of trampling and grazing by cattle, to a minimum.

Since the mid-1970's, the acquisition of vehicles by returning migrant labourers and the upgrading of the main roadlinks (in 1982) have opened up a much larger market for reeds. Prior to this, reed harvesting from the Mosi drainage area was restricted to household use by people living in the immediate vicinity of the wetland. The post-sale distribution of reed bundles clearly shows that this wetland is no longer a local resource area, but is important regionally (Figure 4).

Reeds cut from this wetland supply building material throughout the region and provide a cash income to local families in addition to being a utilitarian resource used by people living adjacent to the wetland. The summer sales peak (Figures 4 and 5) is at the time when men (traditional hut builders and migrant labourers) return home over the Christmas period - the rainy season when most hut building/repairs take place. At major growth points there is more opportunity for local employment and more men are available to do repairs throughout the year, buffering out seasonal demand generated by returning migrant labourers.

Thompson's (1976) view that "....natural swamps do not contribute directly to visible economic effort" is really the result of lack of research on wetland exploitation in Africa. Cutting, transportation and sales are all "informal sector" activities which may be inconspicuous to western eyes, but are obvious to rural Africans. Cyperus latifolius **Poir.**, Cyperus textilis **Thunb.** (ex Cunningham 242, NU), Cyperus natalensis **Hochst.** (ex Cunningham, 231 NU), Cyperus sexangularis **Nees.** (ex Cunningham 237 NU), and Juncus kraussii **Hochst.** were all commercially exploited in my study area and elsewhere (Cunningham and Taylor, in prep.).

In Maputaland, commercial harvesting of P.australis reeds takes place on a greater scale than any of the above species. Similar commercial sales and harvesting of P.australis have also been recorded in villages adjacent to the Linyati Swamps, Botswana (Cunningham, unpublished). In fact man is a major consumer of these wetland species, which are selected for subsistence and commercial use because of the fibrous and durable qualities that restrict their use by herbivores and other consumers.

In common with other tribal areas in southern Africa, the Zulu people have a traditional tenurial right to graze cattle on uncultivated lands and have access to game-meat, water and indigenous plant resources, including reeds. These common property resources are under increasing pressure from the growing population for their own needs and as income. Two factors prove effective disincentives against over-exploitation due to reed cutting.

(i) Prematurely cut stems are less durable and have no commercial value.

(ii) Only tall (3-5 metres high) reeds are in demand for wall-building. Tall reeds are less commonly used as a base for other thatch species (Cunningham, in prep. a). Short reeds which are suitable for thatch are not in sufficient demand to warrant commercial cutting.

Numerous other species are suitable for thatching (Cunningham in prep. a). Although these are less durable than Phragmites, these species provide a finer, more waterproof layer that is easier to penetrate with a thatching needle during thatching.

However without protection from frequent fires, trampling, grazing and intensive cutting during the early growing season, height and cover-abundance of P.australis can be reduced (Haslam, 1968, 1970, 1972; van der Toorn and Mook, 1982).

Even if the shorter stands have a higher shoot density and productivity is not reduced, reduction in stand-height results in economic loss to rural people. Yet the status of reeds as a common property resource complicates management and P.australis stands on the Pongolo floodplain are mismanaged. In the Ndumu Game Reserve, stands are protected from fire and cutting. Reeds are tall (2,0 - 3,0 metres) and have "....high cover-abundance values and a few other species....where its (P.australis) vitality is reduced by cutting and burning....invasion by other species occurs, principally Echinochloa pyramidalis and Eriochloa meyeriana that form a stratum between 0,3 and 0,45 metres" (Furness and Breen, 1980).

Drought periods result in the most intensive exploitation of wetlands by rural people. The lower-water table enables easier access into wetlands for cutting, grazing, burning and agriculture. The effects of drought on the national economy and on commercial and subsistence agriculture results in widespread unemployment and more people fall back on reed cutting as a source of income. At these times reed-beds are most vulnerable to burning. If no burning occurs, cutting of the "standing stock" of accessible mature reeds from the previous season's growth continues into the summer months.

In common with other conservation areas surrounded by rural people (Tinley, 1977; Lusigi, 1981; Mishra, 1982) and others) and the World Conservation Strategy (IUCN, 1980), one of the objectives of local conservation policy is to allow sustainable use of resources within conservation areas. In many cases this ideal is only possible under low population densities. This is not the case in Maputaland which has average population density of 24.3 people/km^2 (Bruton, 1980). While localised species or those with low productivity have theoretical limits to sustainable use, there is such a narrow margin for error between sustained use and over-exploitation that utilization of these species is impractical on a sustainable basis. Naturally occurring populations of these species have to be preserved and alternatives provided by large-scale cultivation outside the reserves (i.e. the only possible sustainable use would be removing seeds for cultivation). This is particularly true of conservation in Africa, where lack of money and man-power limit management and control to basic problems far below the sphere of managing resources on a sustainable basis.

P.australis in the Tembe Elephant Reserve is an exception. A perennial plant with annual shoot production, it represents a productive resource resilient to utilization (Haslam, 1968; van der Toorn and Mook, 1982). Biomass and productivity are high in both temperate and tropical areas (Dykyjova and Hradecka, 1976; Ingram et al., 1980). Formation of pure, monoculture-like stands in sheet-flow areas like the Mosi drainage simplifies management and utilization to a practical level within the constraints imposed by limited economic and man-power resources.

Cutting during winter and cool burning of reed beds can result in a full replacement crop (Haslam, 1968; van der Toorn 1978). Reed-beds benefit from cutting which reduces the effects of shading on growth and removes overwintering sites for the eggs of leaf borers which adversely affect shoot production in Europe (van der Toorn and Mook, 1982) and possibly also in sub-tropical wetlands.

Fencing of the Tembe Elephant Reserve controls access to the wetland. This enables control of the cutting season and burning time, and enables the resource to be managed on a sustainable basis for the benefit of local people. It also provides an example of conservation that rural people can relate to - the sustained supply of an economically important resource. The alternative is the degraded Phragmites community on the Pongolo floodplain, described by Furness and Breen (1980).

However, reed utilization in parks and nature reserves is controversial (Anon, 1980; MacDonald and Schneebeli, 1981; McMillan, 1979) (Appendix II). Much of this controversy can be solved if the management framework of each different reserve is considered individually. In the case of the Tembe Elephant Reserve, management objectives need to take into account not only the biological component of the reserve, but also the socio-economic status of people surrounding the park and their demands on resources within the conservation area. This can be essential to the long-term survival of conservation areas that are under social or political pressure for development (Tinley 1977; Lusigi, 1981). Without this, the primary conservation objective, of maintaining a representative area of tropical dry forest habitat in the Tembe Elephant Reserve may not be achieved.

Reed utilization provides a useful resource, labour employment and income to rural people ajacent to the <u>Phragmites</u> wetlands. Utilitarian and economic benefits from the wetland that accrue to local people from reed sales and tourism help to justify conservation of this wetland. They also provide a strong argument to supplement aesthetic/scientific reasons for maintenance of the wetland in a near-natural state rather than alteration for large-scale agricultural development, which was proposed for the Mosi drainage (Loxton et al., 1969).

In the case of the Tembe Elephant Reserve, the use of a productive, low conservation priority area (the reed-bed) allows strict conservation of the tropical dry habitat which has a high conservation priority. Only 2,28% of this habitat is conserved in southern Africa (Scheepers, 1983). Disturbance to wildlife caused by reed cutting can be minimised through zoning of non-cutting areas at elephant drinking site, which are major drawcards for income producing tourists. Two hundred and fifty three hectares of the 296 hectare <u>P.australis</u> wetland fall within the proclaimed area of the Tembe Elephant Reserve.

Approximately 38 hectares of reeds were short and unsuitable for cutting, 69 hectares were near elephant drinking sites and should be closed to cutting, leaving 153 hectares open to reed harvesting.

Reed cutting can also be a useful management tool and a suitable alternative to burning. In temperate P.australis wetland, cutting/mowing takes place in order to prevent a build-up of organic matter and eventual woody plant succession in the wetland (Gorter, 1962; Husak, 1978).

However, productive as P.australis may be, even reed-beds have a sustainable limit. While alternative building materials can be provided, neither can continue indefinitely. The real question has been posed by Hardin (1977): "what do we want : the maximum number of people at the minimum standard of living - or a smaller number at a comfortable or even gracious standard of living?" Achieving an answer to this lies in the hands of political decision makers, not ecologists. Nevertheless, renewable resources like reeds have to be managed in the interim period (Appendix I).

CONCLUSION

Tall *P.australis* wetlands of the Mosi drainage are an important regional resource, providing building materials and income. Although sales and exploitation are unobtrusive, actual and potential values of this wetland are high. Commercial exploitation has grown up without an input of outside initiative, but has been catalysed by an improved road infrastructure and transport facilities.

While preservation of entire selected ecosystems is the ideal, in this case there is pressure on the land for other uses. Controlled utilization of the reed-bed needs to be seen as a practical and less damaging land-use option than large-scale rice cultivation. Rice cultivation would be incompatible with multiple use of the wetland for building materials and conservation/tourism. Large-scale agricultural disturbance and alteration of the hydrology of the wetland would affect elephant watering areas (which are key drawcards for tourists), reduce local income and the viability of a wider area set aside for conservation of sand forest.

ACKNOWLEDGEMENTS

This study would not have been possible without initial help and encouragement from B. R. Gwala and technical help at various times from I. Gumede, Rev. Khumalo, J. Ncube and J. Ngcobo.

Mr E. Ostrosky, ranger in charge of the Tembe Elephant Reserve, is thanked for his suggestions on non-cutting zones and my supervisor, Professor E. J. Moll for his comments on the manuscript.

The permission from the Director for this project to be conducted whilst I was working for the KwaZulu Bureau of Natural Resources and financial support from them is gratefully acknowledged. However, views expressed in this paper do not necessarily reflect the opinions of this organisation, or any of the above-mentioned individuals.

APPENDIX I

RECOMMENDATIONS

1. Conservation extension and public relations

There must be an increase in sensitive communication with the Tribal Authority and with people surrounding the reserve. For reed exploitation to be a successful part of the "trade-off" where the conservation/tourism option is seen as a viable form of land-use in this low agricultural potential area, it is essential for reed-cutters to understand the reasons for the control of P.australis use. Comparison of P.australis communities inside and outside Ndumu Game Reserve on the Pongolo floodplain provide a local example of uncontrolled use of a common property resource. It is also essential for management staff to have empathy with local sentiment on the restrictions on reed utilization. Rules, regulations and fences are irksome to people who have previously had free access to reeds and other resources. The whole philosophy of integrating conservation with development hinges on local attitudes. These depend not only on the costs in terms of losses accrued through fencing off the conservation area being off-set by material benefits, but also on good public relations.

2. Zoning of cutting areas

Two hundred and fifty three hectares of the 296 hectares of P.australis wetland fall within the proclaimed area of the Tembe Elephant Reserve. Approximately 38 hectares of this were short and unsuitable for cutting, 80 hectares are near elephant drinking sites and should be closed to cutting, leaving 135 hectares open to reed harvesting.

Rotation, in the form of biennial cutting of separate "blocks" of reedbed should be practised as far as possible in the areas open to cutting.

3. Cutting season

Disturbance of wildlife in cut areas should be minimised particularly during the nesting period (spring/summer). This fits in with the peak cutting season (autumn/winter) when there is a slack period in the agricultural cycle. A cutting season from April to August is therefore recommended, to reduce disturbance to wildlife and adverse effects on reed growth.

4. Management of harvesting

(i) Commercial harvesting should be permitted subject to (iii) below.

(ii) Limits on the quantity of reeds available for exploitation should be set on the basis of a yearly field inspection prior to the start of the reed cutting season. An estimate of the expected yield should be based on the area of reeds outside closed zones (Figure 1) that are suitable for cutting (i.e. 3 metres tall), assuming a conservative yield of 500 bundles/hectare (Veber (1978) until this can be updated by a quantatative study of reed production in the Mosi wetland.

(iii) Local people from homesteads that are adjacent to the wetland should be allowed 50 bundles per year for their own use on a special (non-commercial) permit. Over this amount, local people and commercial cutters should buy a yearly permit at a nominal fee (R2,00 → which would be covered by the sale of one bundle). Income from permit sales should be channelled back into the area. Ideally, permits should be per bundle,. but as bundles leaving the wetland would be monitored, tickets would be per person per year.

(iv) Commercial cutting should, if possible, be restricted to people from the Tembe Tribal area, preferably those living adjacent to the reserve. People foreign to the area who come to harvest reeds have far less interest in the long-term viability of the resource and are there primarily to maximise short-term benefits. For local people, the wetland can represent a potential source of income in an area of low agricultural potential, which if overexploited reduces local employment options. If this is the case, then there is incentive for resource management.

(v) Cutting of reeds below the water-line should be discouraged as it is detrimental to reed production. In Europe, repeated underwater mowing is practised to reduce P.australis growth and maintain open-water areas (IUCN, 1962, p. 254). On the Mosi drainage, poor quality P.australis stands invaded by Typha latifolius bordering open water cleared of reeds characterises cattle crossings, probably as a result of similar damage.

(vi) Binding material

Collection of Hyphaene natalensis leaves for binding reed bundles should continue. Bark from Terminalia sericea, Acacia robusta, Acacia borleae, Acacia karroo, Acacia nilotica, Acacia senegal and Ficus capensis growing adjacent to the wetlands are all potential sources of twine but are easily over-exploited. No bark should therefore be used for tying reed bundles.

(vii) Provision of alternative sources of building material at growth point.

If demand increases at the current rate, the maximum sustainable yield will soon be reached (Cunningham, in prep. a). A decrease in demand is unlikely, and alternative reed sources and other building materials need to be provided at growth points, particularly KwaNgwanase, Ndlondlweni, KwaSonto, Phelendaba, Makanes Drift, Zangomeni and Thengane and along the Pongolo floodplain where demand is greatest (Figure 4 and Table 1).

Growth of macrophytes in sewerage ponds has been proposed for urban areas as an aid to water purification (Ashton, 1979; Nicols, 1980; Rogers, 1983). In rural areas, nutrient overloading problems would be avoided as sewerage output (mainly from hospitals) is low, and in contrast to urban areas, would have the added advantage of supplying a useful and economically important resource and deserves further investigation. Concrete block-making can supply alternative building materials as well as create local employment. Current costs of locally made concrete blocks are high and new (competitive) schemes should be initiated (subject to siting away from high conservation priority areas). Restriction of sales to areas north of the foot-and-mouth fence would reduce demand for reeds (44% of the reeds sold during the 15-month monitoring period were transported south of this fence (24% to Ndlondlweni and KwaSonto). This has been suggested by members of the Tembe Tribal Authority and should be considered once alternatives have been provided.

(viii) Further research on *Phragmites* production and dynamics is necessary in order to update management proposals and quota limits. There is also a need for studies of nutrient cycling in African wetlands as most research to date has been done in temperate areas. Although mineral nutrient content (N, P, K) of *P.australis* shoots decreases with the age of the plant (Dykyjova and Hradecka, 1976) and although only mature reeds are exported from the wetland, this nutrient export could eventually result in nutrient depletion (Thompson, 1976).

APPENDIX II

REED UTILIZATION IN CONSERVATION AREAS

We are unfortunately a long way from achieving the conservation "land-ethic" (Leopold, 1970). Unless conservation can justify itself in developing areas, reserves could be swallowed up in the short term by socio-political pressure for development. Resentment felt by rural people in developing countries against conservation areas is widespread and can threaten the future of these parks unless local people are able to reap benefits from such areas (Lusigi, 1981; Saitoti, 1978; Mishra, 1982; Tinley, 1979). Unless building materials are provided, either preservation or agricultural development would effectively cut off local people from a reed supply.

In such cases, decisions have to made on the current state of knowledge in order to avoid more serious immediate threats to conservation areas than possible long-term nutrient depletion in the wetland that could arise from reed harvesting. For example, hydrological disturbance associated with large scale rice cultivation would have a far wider reaching and more immediate effect. MacDonald and Schneebeli,(1981) suggested that reed cutting in the Umfolozi-Hluhluwe Game Reserve, South Africa, be terminated on both ecological (disturbance to wild life and reed biology, litter production and decomposition, fire characteristics and microclimate) and ethical grounds (that consumptive utilization "jeopardized the (Umfolozi-Hluhluwe) complex's status as a genuine nature conservation area, reducing it to that of an agricultural production area"). A short-term follow up study by Frankland (1982) was initiated at this locality to investigate the effects of reed utilization. This showed higher mammal densities (particularly Praomys natalensis) and a greater number of Yellow weaver (Ploceus subaureus) nests in cut than in uncut areas, but other results were inconclusive. However, his data does support records from Europe, where breakdown in reed-bed homogeneity has been linked to increases in bird population through opening up feeding sites (for heron species) or breeding sites for bird species nesting preferentially at reed margins (due to the increased "edge effect" with reed cutting) (IUCN, 1962).

In such cases, the location, timing and extent of reed-cutting could boost populations of species living in reed-beds or improve the success of raptors preying on rodents. Biennial clearing does result in a breakdown of reed homogeneity (Figure 2; Frankland, 1982; van der Toorn and Mook, 1982) and in contrast to MacDonald and Schneebeli's (1981) view, reed cutting could enhance conservation efforts by increasing micro-habitat and species diversity in P.australis reed-beds plant community.

In other areas disturbance associated with reed harvesting could adversely affect reed-bed species. The P.australis method in Ndumu Game Reserve, for example, is one of the two known breeding areas of the Open-bill stork (Anostomus lamalligerus) in South Africa (Heeg and Breen, 1982). In the Mkuze swamps, disturbance by reed cutters has reduced the number of Nile crocodile (Crocodylus niloticus) nesting sites (Pooley, 1982) and in the Hluhluwe Game Reserve, a nest site of the rare White-backed heron (Gorsachius leuconotus) (Kemp, 1973). In the Tembe Elephant Reserve this will be avoided by zoning of non-cutting areas.

Commercial harvesting is equally controversial. Even in national parks where the needs of local people surrounding the park/reserve are taken into account, commercial harvesting is usually ruled out. Canadian National Parks' policy (1980) for example clearly says that within the constraints of maintaining ecosystem functioning and viable populations of fish and wildlife species,

".....certain traditional activities will be permitted in the following circumstances: In new national parks, guarantees will be provided so that certain traditional subsistence resource uses will be permitted to continue in parts of national parks for one or more generations when such uses are an essential part of the local way of life and when no alternatives exist outside park boundaries. These exceptions will be agreed to at the time of formal establishment of a new national park and will be outlined in the park management plan" but, that "commercial exploitation, extraction or developoment of natural resources will not be permitted in a national park".

Klingelhoeffer (1982) recommended that local people should be allowed to cut reeds in the Tembe Elephant Reserve. This study has determined that commercial harvesting accounts for the majority of reed utilization from the reserve, but supports this recommendation because of the sparse population adjacent to the wetland area and the importance of reeds and the role that Phragmites utilization can play as a productive easily managed resource, and low subsistence demand on the reed-bed.

LITERATURE CITED

Anon (1980) Parks Canada Policy. Parks Canada, 10 Wellington Street, Hull; Quebec K1A 162.

Ashton, P.J. 1979. The production and potential uses of macrophytes grown in wastewater. Council for Scientific and Industrial Research, Reprint RW794, Pretoria.

Cunningham, A.B. in prep a. Use and management of hut-building resources used by rural people in Maputaland, South Africa.

Cunningham, A.B. in prep b. Palm wine tapping in Maputaland, South Africa I. Contribution to the regional rural economy.

Cunningham, A.B. and Taylor R.H. in prep. Utilization of <u>Juncus kraussii</u> **Hochst** at St. Lucia estuary, Natal.

Dykyjova, D. and D. Hradecka, 1976. Production ecology of <u>Phragmites communis</u> 1. Relations of two ecotypes to the mocroclimate and nutrient conditions of habitat. Folia Geobot. Phytotax., Praha 11 : 23 - 61.

Frankland, C.A. 1982. The impact of annual reed cutting on the ecology of the Fuyeni reedbed. Unpublished B.Sc (Hons.) thesis, Dept. of Biological Sciences, University of Natal, South Africa.

Furness, H.D. and Breen, C.M. 1980. The vegetation of seasonally flooded areas of the Pongolo river floodplain. Bothalia 13 : 217-231.

Gorter, H.P. 1962. Conservation and management of the Netherlands Lowlands marshes In Project Mar : The Conservation and management of temperate bogs and other wetlands. Vol I. IUCN publications New Series No. 3. Proceedings of the MAR conference, Nov. 12 - 16, 1962.

Guedes, A.A. 1971. The Canicos of Mozambique p. 200-209 in : Shelter in Africa. Oliver, P, Barrie and Jenkins, London.

Haslam, S.M. 1968. The biology of reed (Phragmites communis) in relation to its control. Proc. 9th Brit. Weed Control Conf. 392-397.

Haslam, S.M. 1970. The performance of Phragmites communis **Trin.** in relation to water-supply. Ann. Bot. 34 : 867-877.

Haslam, S.M. 1972. Phragmites communis **Trin.** Biological flora of the British isles. J. Ecol. 60 : 585-610.

Hardin, G.J. 1977. The limited of altrusium - an ecologists view of survival. Bloomington, Indiana U.P. 154 pp.

Heeg, J. and C.M. Breen, 1982. Man and the Pongolo floodplain. S.A. National Scientific Programmes Report No. 56 June 1982.

Husak, S. 1978. Control of reed and reed mace stands by cutting In Pond littoral ecosystems : Structure and functioning, Dykyjova, D. and J. Kvet, ed Springer-Verlag, New York.

IUCN. 1962. Project Mar : The conservation and management of temperate bogs and other wetlands. Volume 1. IUCN publications New Series No 3. Proceedings of MAR conference, Nov 12-16, 1962.

IUCN. 1980. World Conservation Strategy. International Union for Conservation of Nature and Natural Resources, Morges, Switzerland.

Jacot-Guillarmod, A. 1971. Flora of Lesotho. Lehre, Verlag von J. Cramer.

Kemp, M.E. 1973. A breeding record of the White-backed Night Heron. Afr. Wildlife 27 : 182-183.

Kligelhoeffer, E.W. 1982. Recommendations for the proposed Tembe Elephant Reserve in Tongaland, Northern Natal: Boundaries and a management development plan. Unpublished report.

Leopold, A. 1970. The Conservation ethic. in The Ecological Conscience, Disch, R. ed, Prentice Hall, Englewood Cliffs, New Jersey.

Liengme, C.A. 1983. Plants used by the Tsonga people of Gazankulu. Bothalia 13 : 501-518.

Loxton, Hunting and Associates. 1969. The Natural Resources of Maputaland. Recommended land-use systems. Map 10. Unpublished map series.

Lusigi, W.J. 1981. New approaches to wildlife conservation in Kenya. Ambio 10 : 87-92.

MacDonald, I.A.W. and Schneebeli, B.E. 1981. The impact of reed cutting on the ecology of the Fuyeni reedbed, Umfolozi Game Reserve - a report on preliminary investigations carried out during September 1981. Unpublished report, 7pp. Natal Parks Game and Fish Preservation Board, Pietermaritzburg, Natal, South Africa.

McMillan, R.L. 1979. an investigation into the commercial harvesting of the Tay Reed Beds with emphasis on some Nature Conservation Aspects. Unpublished M.A. disertation, Dept. Geography, Dundee University 57 pp.

Mishra, H.T. 1982. Balancing human needs and conservation in Nepal's Royal Chitwan National Park. Ambio 11: 246-251.

Nichols, D.S. 1980. Nutrient removal from wastewater by wetlands, In proceedings Sixth International Peat Congress; August 17 - 23, 1980. W.A. Fisher Co. 1981.

Pooley, A.C. 1982. Further observations on the Nile Crocodile Crocodylus niloticus in the St. Lucia Lake System. In St. Lucia Research Review. R.H. Taylor ed Natal Parks Game and Fish Preservation Board, Pietermaritzburg, Natal, South Africa.

Rogers, F.E.J. 1983. Wetlands as accreting systems: wastewater treatment. J. Limnol. Soc. Sth. Afr. 9 : 110-116.

Saitoti, T.O. 1978. A Maasai looks at the ecology of Maasailand. Munger African Library Notes. Issue No. 42 : 1-25.

Scheepers, J.C. 1983. The present status of vegetation conservation in South Africa. Bothalia 14 : 991-995.

Thompson, K. 1976. The primary productivity of African wetlands with particular reference to the Okavango Delta and its future utilization. In : Proceedings of the Symposium on the Okavango and its future utilization, August 30 - September 2 1976, National Museum, Gaborone, Botswana.

Tinley, K.L. 1977. Framework of the Gorongoza ecosystem, Mocambique, Hennies Printers, Pretoria.

Tinley, K.L. 1979. The maintenance of wilderness diversity in Africa In Voices of the Wilderness Congress, Jonathan Ball Publishers.

Van Der Toorn, J. 1978. Effect of cutting on reed performance. Ver. Kon. Ned. Adad. Wetensch., Afd. Natuurk, 2e Reeks 73 : 335-339.

Van Der Toorn, J. and J.H. Mook. 1982. The influence of environmental factors and management on stands of *Phragmites australis* 1. Effects of burning, frost and insect damage on shoot density and shoot size. J. Appl. Ecol. 19 : 477-499.

Veber, K. 1978. Propagation, cultivation and exploitation of common reed in Czechoslovakia. In Pond littoral ecosystems : Structure and functioning, Dykyjova, D. and J. Kvet, ed, Springer-Verlag, New York.

Zonderwijk, O. 1962. Management of reed-lands in the Netherlands. In project Mar : The conservation and management of temperate bogs and other wetlands. IUCN publication new series No. 3. Proceedings of the MAR conference, Nov 12-16, 1962.

HUT BUILDING RESOURCE USE BY RURAL PEOPLE IN MAPUTALAND, SOUTH AFRICA

A B CUNNINGHAM* AND T T DUNNE**

ABSTRACT

The objective of this study was firstly to determine the extent of use of indigenous plants for hut building by Zulu and Tembe-Thonga people on the Maputaland coastal plain, and secondly to assess hut building trends in this area. Indigenous plants were the primary source of thatch, reeds and wood for building material. Use of these materials varied with vegetation type. While average requirements per hut for roofing (276 kg of thatch, 202 kg of wood) and roof-support poles (231 kg) remained relatively constant for the "typical" hut types, wood and reed requirements for the two main styles of wall building differed greatly. Lath-woven walls required an estimated 1980 kg of wood (1400-2000 hardwood laths) per hut. These huts were built mainly in the Sand Forest ecological zone where forest and thicket were widespread. In other ecological zones, Phragmites reed walls were most common, using an estimated 204 kg of reeds and 98 kg of wooden laths per hut. The rate of increase in hut numbers in the study area over the past nine years (1974-1983) has been 4.37% per annum. At specific sites where stores, schools and clinics are situated, the increase was even more rapid. This increase has resulted in greater intensity and frequency of harvesting plant materials, clearing for agriculture, grazing and burning. Due to a low "turnover" rate, the estimated annual use of wood for hut building was negligible compared to fuelwood use, but both types of wood use were considered negligible in comparison with the over-riding effects of agricultural clearing, high stock numbers and fire on forest, thicket and woodland.

Departments of Botany(*) and Mathematical Statistics(**)
University of Cape Town, RONDEBOSCH 7700

INTRODUCTION

Provision of low-cost housing is a growing problem in developing countries. Indigenous plants provide a low-cost source of building material in many rural areas of southern Africa (Malan and Owen-Smith, 1974; Knuffel, 1973; Van Voorthuizen and Odell, 1976; Whitlow, 1979; Johnson, 1982; Liengme, 1983). There are many advantages associated with the use of indigenous plant material in Africa. Firstly, they are a renewable source of building material. Secondly, their harvesting, transport, sale and use generates income and preserves traditional building skills (van Voorthuizen and Odell, 1976; Cunningham and Gwala, in prep). Thirdly, the dwellings are insulated and well suited to African climatic conditions (Knuffel, 1973; Siegfried, 1984) and fourthly, they are often the least expensive of the valuable building materials (van Voorthuizen and Odell, 1976; Deitz, 1979; Frescura, 1981; Johnson, 1982).

Indigenous materials are widely recommended for use in low-cost housing in developing countries because of these advantages (Deitz,1979). With the high population growth rates and low socio-economic status of many areas, there is little doubt that pressure on these resources will increase. In 1889, James Ralfe suggested that an estimate should be made of the amount of wood used for Zulu huts in the Natal Colony after finding that over 1000 laths were used per hut (Colony of Natal, 1889). Yet despite increasing demands and in some cases, depletion of building materials (Fleuret, 1980; Frescura, 1981) few studies have quantified the importance or extent of use of hut building materials. Van Voorthuizen and Odell (1976) assessed the quantity of thatch required for roofing. Knuffel (1973) counted the number of laths used in constructing the traditional Ngwane grass hut but did not quantify their volume or mass. Wood requirements for Tsonga hut construction were studied in more detail by Liengme (1983) who calculated the volume of timber used in construction of homes and storage huts. On this basis, using the increase in the number of homes and storage huts over a twelve month period amongst a population of known size, Liengme (1983) estimated wood use for building purposes to be 230 kg per family^{-1} year^{-1}.

In the Ingwavuma district, Natal, South Africa, the influx of people to developing villages, where educational and economic opportunities are available, has resulted in clearing of the surrounding forest and woodland for agriculture. This has concentrated pressure on the remaining sources of wood and has generated harvesting and commercial sale of <u>Phragmites australis</u> reeds to satisfy some of the demand at these sites (Cunningham, in prep). The aim of this study was to assess the importance of indigenous plants for building purposes, the distribution of hut building activity and to estimate the extent of use of indigenous plant resources for building.

METHODS

Plant species used for hut building by rural people in the study area were identified during fieldwork (Cunningham and Gwala, in prep). Their extent of use in hut building was then determined from huts in the four main areas where settlement has taken place (Figure 1). These were as follows:

i) in the Coast Zone, between the sea and the Kosi lake system

ii) in the Coastal Lake Zone

iii) along the western border of the Mosi-Palm Zone (adjacent to the Sand Forest Zone)

iv) along the western boundary of the Sand Forest Zone adjacent to the Pongolo floodplain.

Although many of these people were farming on alluvial soils of the floodplain which lay outside the study area, the Sand Forest Zone provided a major source of laths and poles. For this reason these huts were included in the survey.

Sampling of huts was not random. As shown by the distribution of agricultural disturbance, settlement is concentrated in the Coast and Coastal Lake Zones of the study area (Figure 1 and 2) where wetlands, stores and/or informal marketing points provide the major foci of settlement. These settled areas are criss-crossed by tracks and all huts visible from these tracks

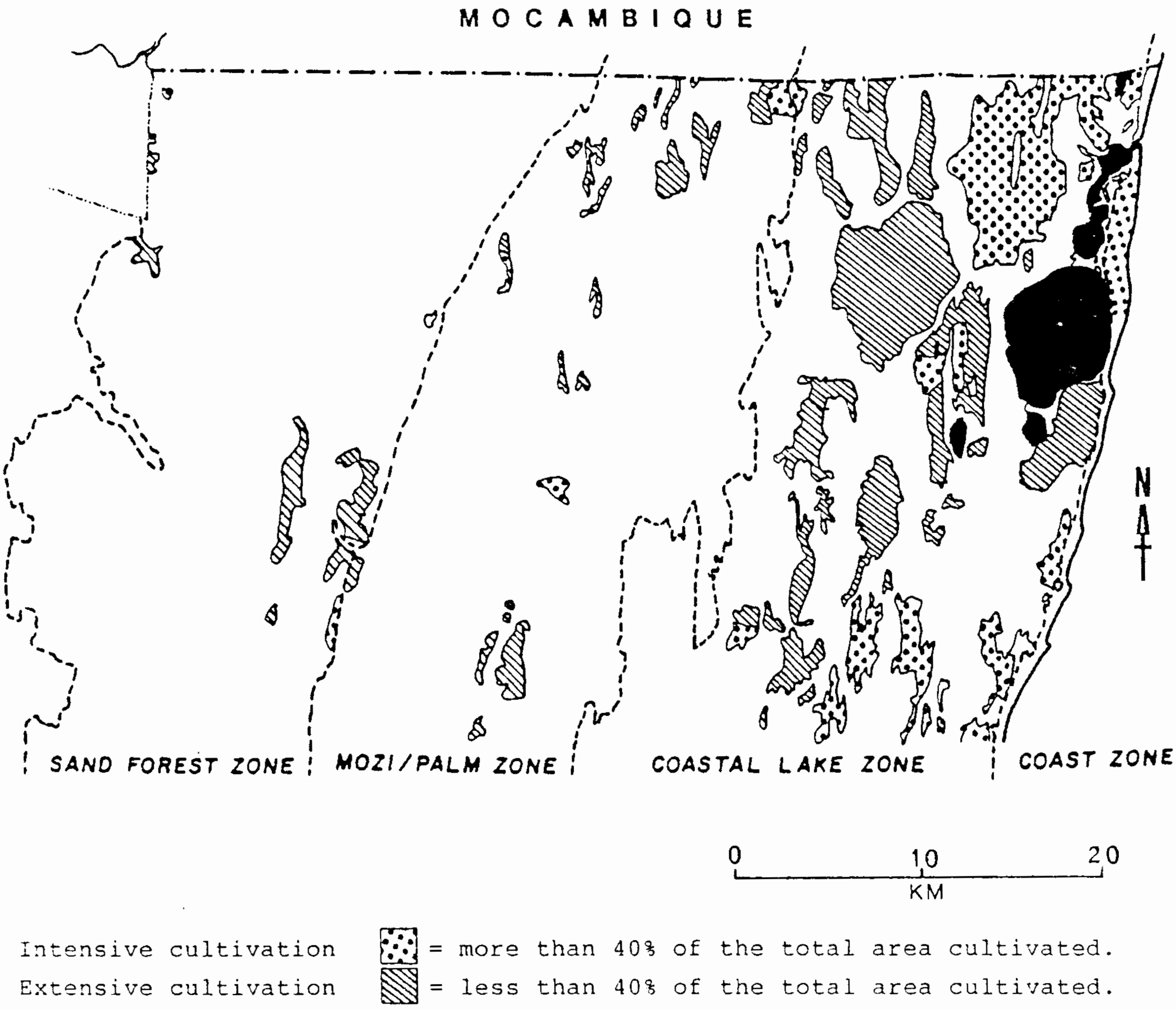


Figure 1. Distribution of cultivated land in the study area (after Loxton et al, 1969) in relation to ecological zones (from Tinley and van Riet, 1981) showing the concentration of settlement sites (and consequently of agricultural clearing) in the Coastal Lake Zone.

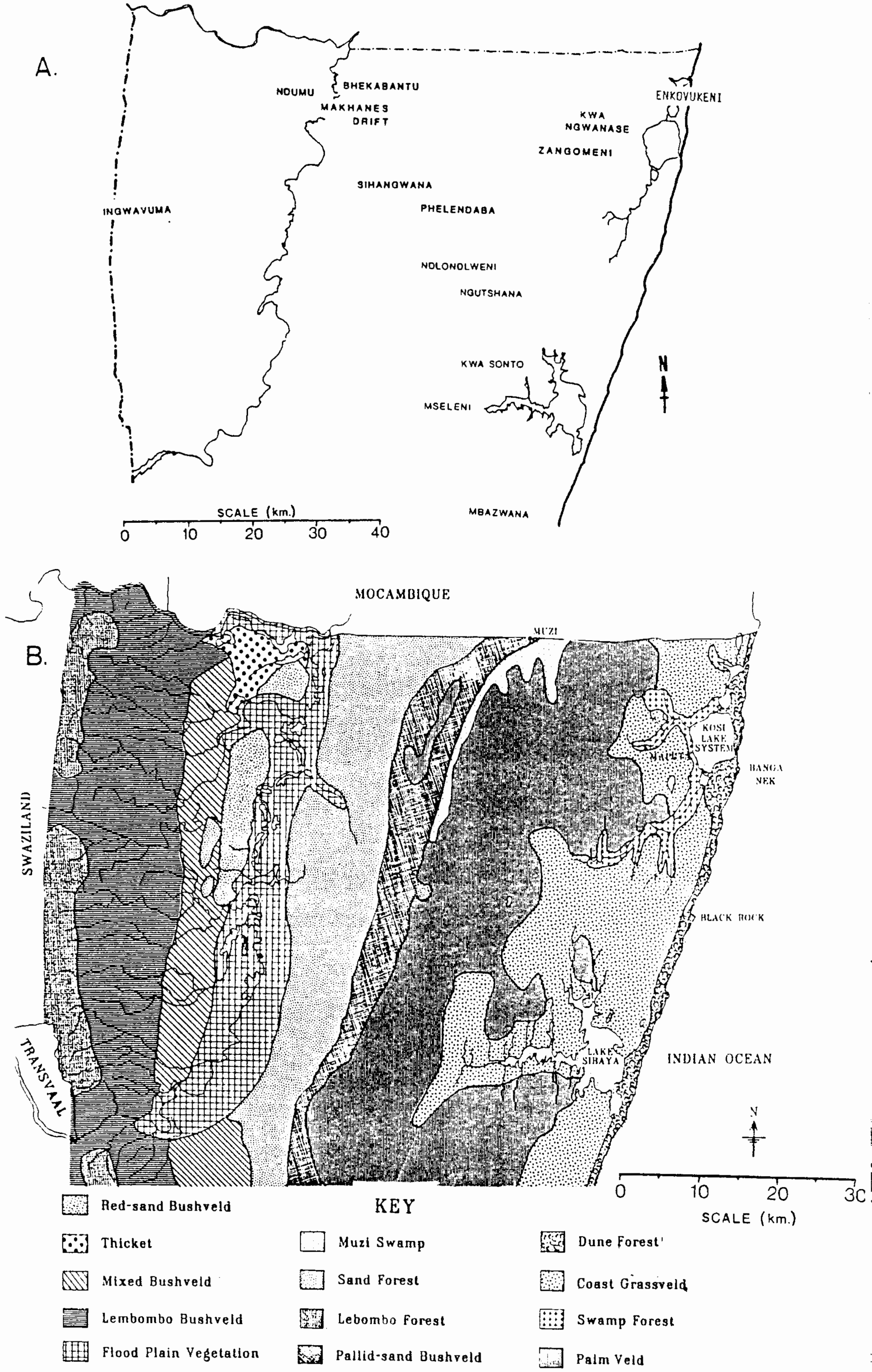


Figure 2. (A) The location of the main settlement sites mentioned in the text and (B) the major vegetation zones in Maputaland (Moll, 1978).

were included in the sample. The only area that was not accessible by vehicle was eNkovukeni and this was covered on foot. Clinics, mission hospital buildings, schools and stores were not included in the sample. Despite being non-random, the sample of 645 huts (a 5.3% sample of the huts in the study area at the time of the survey (1980)) was considered to be representative of hut building trends in each ecological zone.

Building materials were divided into two broad groups: roofing materials and wall building materials. Grain storage huts were ignored in this area as, though numerous, they are small and the quantity of materials used in their construction was minimal. Roofing materials (including the various thatch species used) have a characteristic appearance (Figure 3) and were identified by field inspection. In cases where more than one species was used for thatching a hut (Figure 3D) or where Phragmites reeds were used as a base for thatch, a visual estimate was made of the proportion of each species represented. Wall building materials were divided into four classes:

i) Reed walls (Figure 4C)

ii) Lath-woven (uphico) walls (Figure 4B)

iii) Branches packed vertically into a lath framework (Figure 4A)

iv) Other materials (broken bricks, Raphia and Phoenix palm rachi, etc.

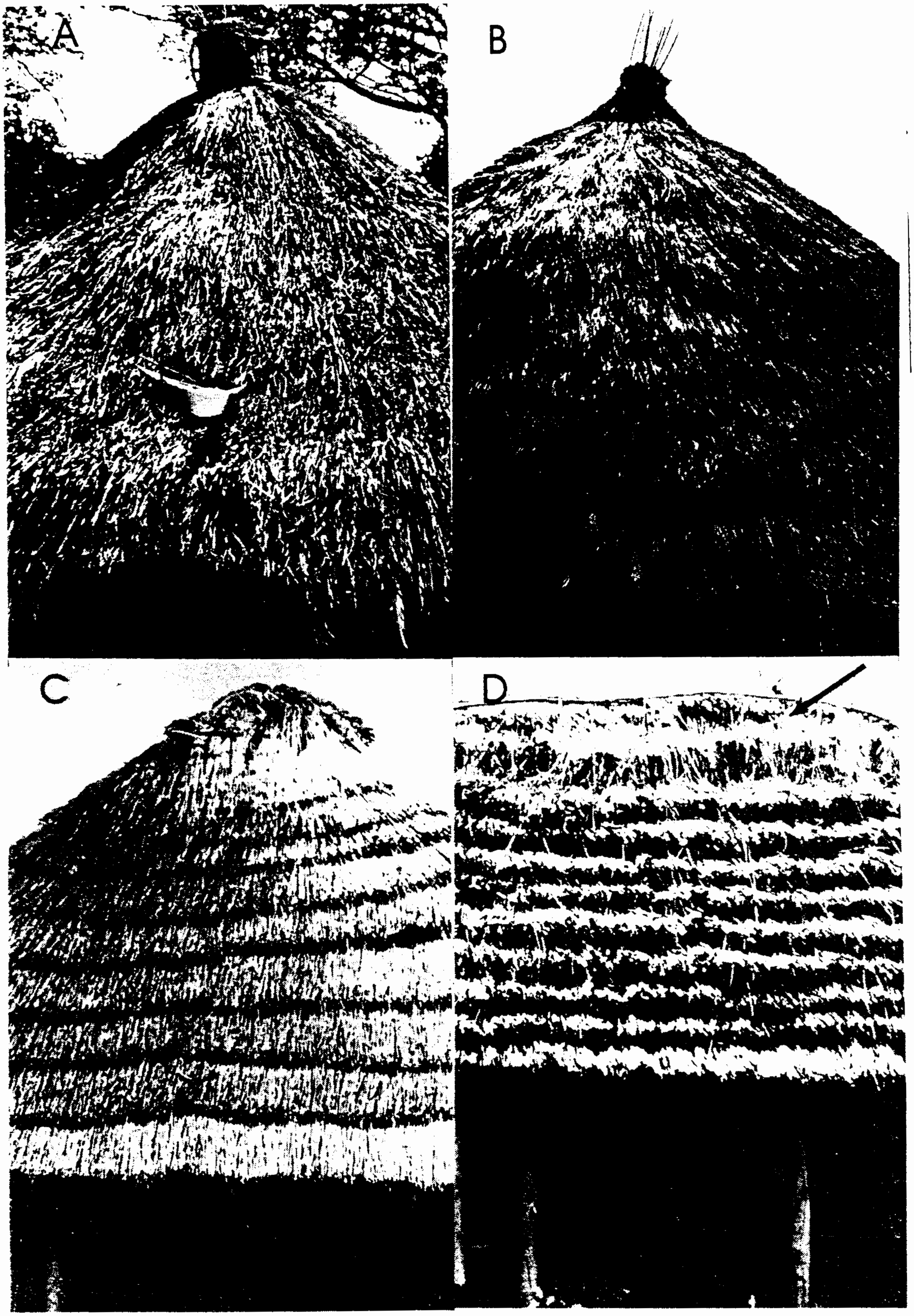


Figure 3. The main thatch types used on the coastal plain showing their characteristic appearance resulting from differing stem size and leaf length. A. Cladium mariscus (long, robust, serrated leaves). B. Imperata cylindrica (short and comparitively narrow leaves). C. Hyperthelia dissoluta (robust cylindrical stems). D. Cyperus latifolius (broad leaf blades) with I.cylindrica on roof ridge indicated by the arrow.

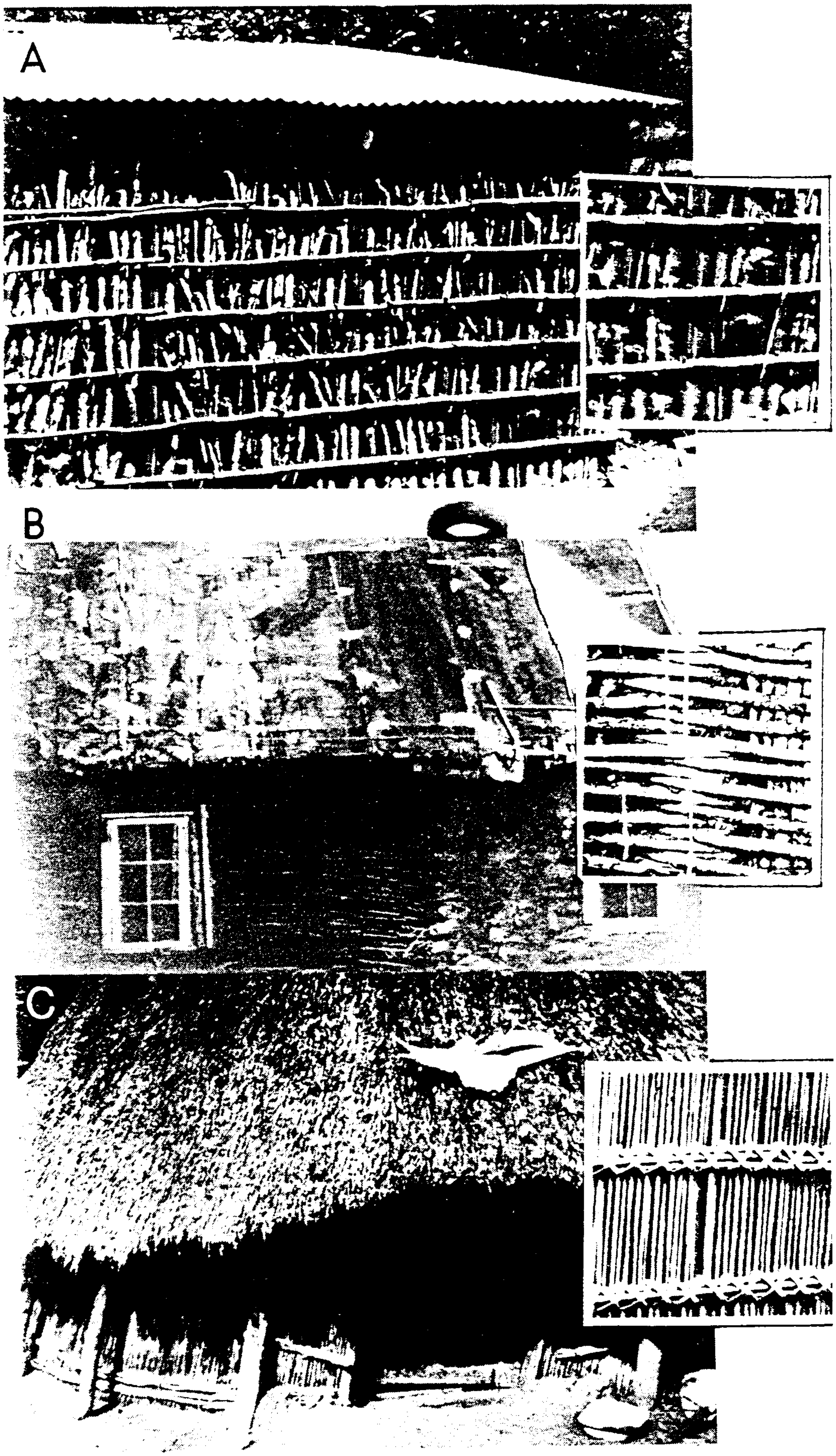


Figure 4. The two artificial roofing types and the three main styles of wall building (shown in detail in respective insets to each figure).

A. Corrugated-iron roof with a wall made from upright branches packed between a wooden framework.

B. Damp-coursing roof with a wall of woven laths (uphico).

C. Thatched hut with reed wall and supporting laths.

Reeds and bundles of hardwood laths collected for building were weighed at building sites. Reed bundles were also weighed at the Phelendaba reed sale point. The quantity of materials used in building was recorded in terms of the number of bundles per hut at these sites, and from discussions with local hut builders.

Three aspects of "hut population dynamics" were relevant to the aims of this study:

a) the change in hut number in the study area as a whole
b) the change in hut number in each ecological zone as defined by Tinley and van Riet (1981) as a basis for their land-use proposals
c) the change in hut number at settlement points both inside and outside the study area whose growth was generating a demand for commercially exploited building material cut within the study area (Cunningham, in prep a).

Hut density and the change in hut numbers from 1969 - 1983 was determined from hut counts made by malaria surveillance officers and obtained from the KwaZulu Department of Health*. These counts are made throughout the Ingwavuma and Ubombo districts, with the exception of the Lebombo mountain, area which is away from the main malaria danger area. All the available hut count

* KwaZulu Department of Health, Private Bag X002, JOZINI

data was used. Hut numbers for the eNkovukeni area in 1964 were derived from counts made by Felgate (1965, 1982).

Each district is divided into sub-units to facilitate the malaria control spraying (Appendix I). Hut densities at the main growth points were determined on the basis of these units which were demarcated by roads, tracks or swamp areas. With the help of malaria surveillance officers in the study area and a map from the KwaZulu Department of Health (which showed the sub-unit boundaries but was not to scale) the sub-units were plotted onto 1:50 000 map sheets or aerial photographs. The areas of the main settlement sites within these sub-units (Table 1) were measured using a Tektronix Digitiser in order to calculate hut densities. It was not possible to accurately locate the boundaries in the eSicabazini/Mpophomeni area.

The hut numbers within the sub-units were also used to determine the hut numbers within the ecological zones. Where the sub-units overlapped the ecological zone boundaries, hut numbers within these sub-units were divided proportionately to area as as to determine the apparent hut numbers within each ecological zone.

RESULTS

BUILDING ACTIVITY

Over the nine year period 1974 - 1983 there was an average annual rate of increase in hut number of 4.37% per year in the study area (an average increase of 504.5 huts/year). However, the rate of increase varied between ecological zones (Table 2) and respective settlement sites (Figure 5, Tables 2 and 3). The largest and most rapid increase was in the Coastal Lake Zone, followed by similar rates of increase in the Sand Forest and Mosi-Palm Zones (Table 2). Hut numbers stayed relatively constant in the Coast Zone probably because most of this area is a declared forest reserve (Government Gazette, 1952).

Homestead sites were not evenly spaced but were centred around wetlands or points where stores, schools or clinics were situated. The broad trends shown in Table 2 therefore mask the different rates of increase at specific sites within each ecological zone. The largest increases in hut number were in the Mbazwana, Ndumu, Mseleni, Zangomeni and KwaNgwanase areas (Table 1). However, the rates of increase at the oldest trading points (Mseleni, Ndumu and KwaNgwanase), were slower than the increases at their peripheri (eg. Zangomeni), where new stores and schools had been built (eg. Ndlondlweni), or where improvements to the road infrastructure had enhanced the opportunities for informal marketing (eg. Makhane's Drift). The lowest rates of increase

Table 1. The change in hut number and density in selected sections of the study area and in major settlement sites in Maputaland whose growth has created a demand for building materials (Phragmites australis reeds (Cunningham, in prep a)). Hut densities were only determined for sites within the study area. A decreasing hut number or density is indicated by a negative sign.

Area Name	Mean annual change in hut number		Percentage change in hut number	Area (km^2)	Hut density	
	1969-1974	1974-1983	1974-1983		1974	1983
Ndlondlweni	-5.8+	16.5	233.0**	21.2	3.0	10.0
KwaNgwanase		77.9	45	121.2	13.0	18.8
Ndumu		120.2	41	-	-	-
Makhane's Drift		45.4	195	25.9	7.8	23.7
KwaSonto		8.6	9	88.5	9.3	10.1
Bhekabantu		36.0	62	-	-	-
Phelendaba		5.1	44	22.0	4.7	6.8
Sihangwana		1.1	13	12.2	6.1	7.0
Zangomeni		117.3	275	43.2	8.9	33.5
Mabibi		4.7	10	44.8	9.3	10.2
eNkovukeni	6.9*	-20.6	-59	14.3	22.1	9.1
Mseleni	70.8	87.6	51	-	-	-
Tshongwe	19	23.9	37	-	-	-
Mbazwana	13.4	149.3	116	-	-	-
KwaMshudu		15.7	25	55.0	10.4	12.9
Kosi Bay [1]		0.9	1.2	36.1	18.1	18.3

* This represents the change in hut number over the 10 year period 1964-1974.

1 This refers to the KwaMazambane, KwaMahlungulu and Mvutshana areas.

+ This probably reflects an underestimate of hut number in 1974.

Table 2. The increase in hut number in the study area and in the four ecological zones over the nine year period (1974-1983). Fractions in each year total result from divisions of Department of Health sub-units used to calculate hut number by ecological zone boundaries.

ECOLOGICAL ZONE	COAST	COASTAL LAKE	MOSI-PALM	SAND FOREST	TOTAL
YEAR					
1974	443.6	5328.2	1920.5	1966.4	9658.7
1976	394	5452.3	2838.8	2636.4	11321.5
1977	386.9	5608.6	2766.2	2602.5	11364.2
1978	386.9*	5608.6*	2766.2*	2602.5*	11364.2*
1980	335.3	6456.8	2652	2743.4	12187.5
1983	267	7777	2930	3226	14200

*Almost certainly underestimates (see Table 3).

Table 3. Changing hut numbers at specific sites in the Maputaland area between 1964 and 1983. Location of Department of Health (malaria control) sub-units given in brackets after each site are given in Appendix I.

	1964	1969	1970	1971	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	ZONE
NDLONDLWENI (NG3)		76		116	64°		161	161	161°		155°			213	MOSI-PALM
KWANGWANASE (MP 1-10)					1 573		1 652	1 689	1 689°	1 689°	2 024	2 640**		2 274	COASTAL LAKE
NDUMU (ND 1-10)					2 670	2 670	2 813	2 813	2 813°	2 813°	3 274	3 232		3 752	PONGOLO
MAKHANE'S DRIFT (MK 9, MK 10, T8)					206		441	441	441°		561			615	PONGOLO/SAND FOREST
KWASONTO (LS 4-9)			683		820		1 003	804	804°		963			897	COASTAL LAKE
BHEKABANTU (MK 3-7)					520		848		927		841			844	PONGOLO/SAND FOREST
PHELENDABA (S7)					104		166	-	269		162			150	MOSI-PALM
SIHANGWANA (S1, S2, NG1)					75		76		56		95			85	SAND FOREST
ZANGOMENI (M 10, KZ1)					386		536		906		1 151			1 446	COASTAL LAKE
MABIBI (LS1, LS2)			355		417			422	422°		479			459	COAST/COASTAL LAKE
ENKOVUKENI (BH1, BH2)*	240				316				232		194			130	COAST
MSELENI (MS 1-10)		1 196			1 550		1 638	1 966	1 966°		2 009			2 338	MOSI-PALM/COASTAL LAKE
TSHONGWE (TS 1-5)		490			585			764			819			800	SAND FOREST
MBAZWANA (MB 1-5)		1 093			1 160			2 045			2 267			2 504	COASTAL LAKE
KWAMSHUDU (KM 1, 6-8)					570			538	538°		562			712	MOSI-PALM/COASTAL LAKE
KOSI BAY (KB 3-5, 7-9)					653			625	625°		647			1 652	COASTAL LAKE
(* KwaMshudu, KwaMazambane, KwaMvutshana)															

° = almost certainly underestimated

** = almost certainly overestimated

occurred in the Sihangwana, Mabibi, KwaSonto and Kosi Bay (KwaMazambane, KwaMahlungulu, KwaMvutshana) areas (Table 3). The most marked decrease in hut number occurred in the eNkovukeni area (Figure 5, Table 1).

EXTENT OF USE OF BUILDING MATERIALS

Hut building materials reflected the siting of the homesteads in relation to their proximity to economic growth points and the surrounding vegetation (Figure 6).

Indigenous plant resources were the major source of building material. Corrugated iron and damp coursing (a bitumen impregnated sheeting used between brickwork of urban houses) (Figure 4) were most commonly used in the vicinity of economic growth points and only formed 20% of the huts in the sample. Roofing with these materials was most evident near KwaNgwanase. *Imperata cylindrica* was the dominant roofing material on the coastal plain but was not used for thatching any of the huts along the western boundary of the Sand Forest Zone. In this area (which is adjacent to the Pongola floodplain) *Cyperus fastigiatus* and *Eriochloa meyeriana* were dominant roofing materials. *Cyperus latifolius* and *Cladium mariscus* were not used for thatching along the floodplain but on the sandy coastal plain they were most commonly used for thatching huts adjacent

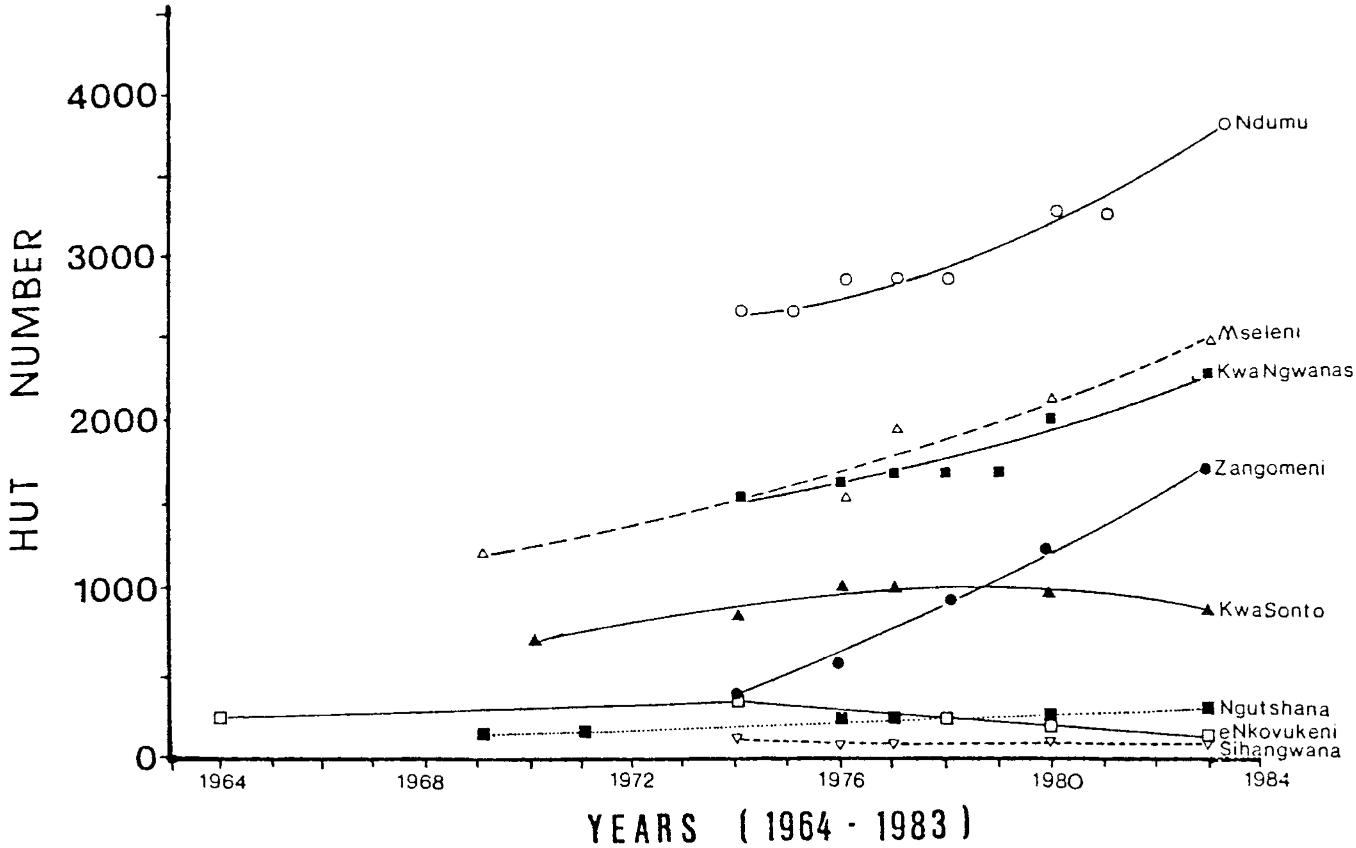


Figure 5. Changes in hut number (1964-1983) at a range of sites in Maputaland showing the high hut numbers at well established trading sites, the rapid growth of hut numbers at their peripheri (Zangomeni), and constant or declining hut numbers at sites away from stores and schools (eg. eNkovukeni).

and walls) according to ecological zones. Shading shows sampled areas. Roofing (upper histograms) to the wetlands of the Kosi system and Mosi drainage. Use of *Hyperthelia dissoluta* was also limited to huts on the sandy coastal plain. *Rhynchelytrum repens* and *Hemarthria altissima* were infrequently used.

THATCH DURABILITY

The durability of thatch species depended on the thatching method, the skill of the thatcher and the pitch of the hut roof. All of these varied considerably, but hut builders agreed that, in most cases, they could estimate the length of time that the various thatch species would last. For the purpose of calculating the quantity of thatch used in the area, thatch grass and sedge species were divided into three categories based on the hut-builders estimates (Table 4).

WALL BUILDING

Two basic types of wall building material dominated housing in the study area. On the coastal plain, *P. australis* reeds were the dominant wall building material (Figure 6). In the Sand Forest Zone adjacent to the Pongola floodplain, *P. australis* and *P. mauritianus* were used but lath-woven walls dominated as a wall construction material. Walls made of broken bricks and branches between a wooden framework (Figure 6) were most common in the Coastal Lake Zone but were a less frequent elsewhere. *Raphia australis* and *Phoenix reclinata* rachis use was also infrequent (Figure 6).

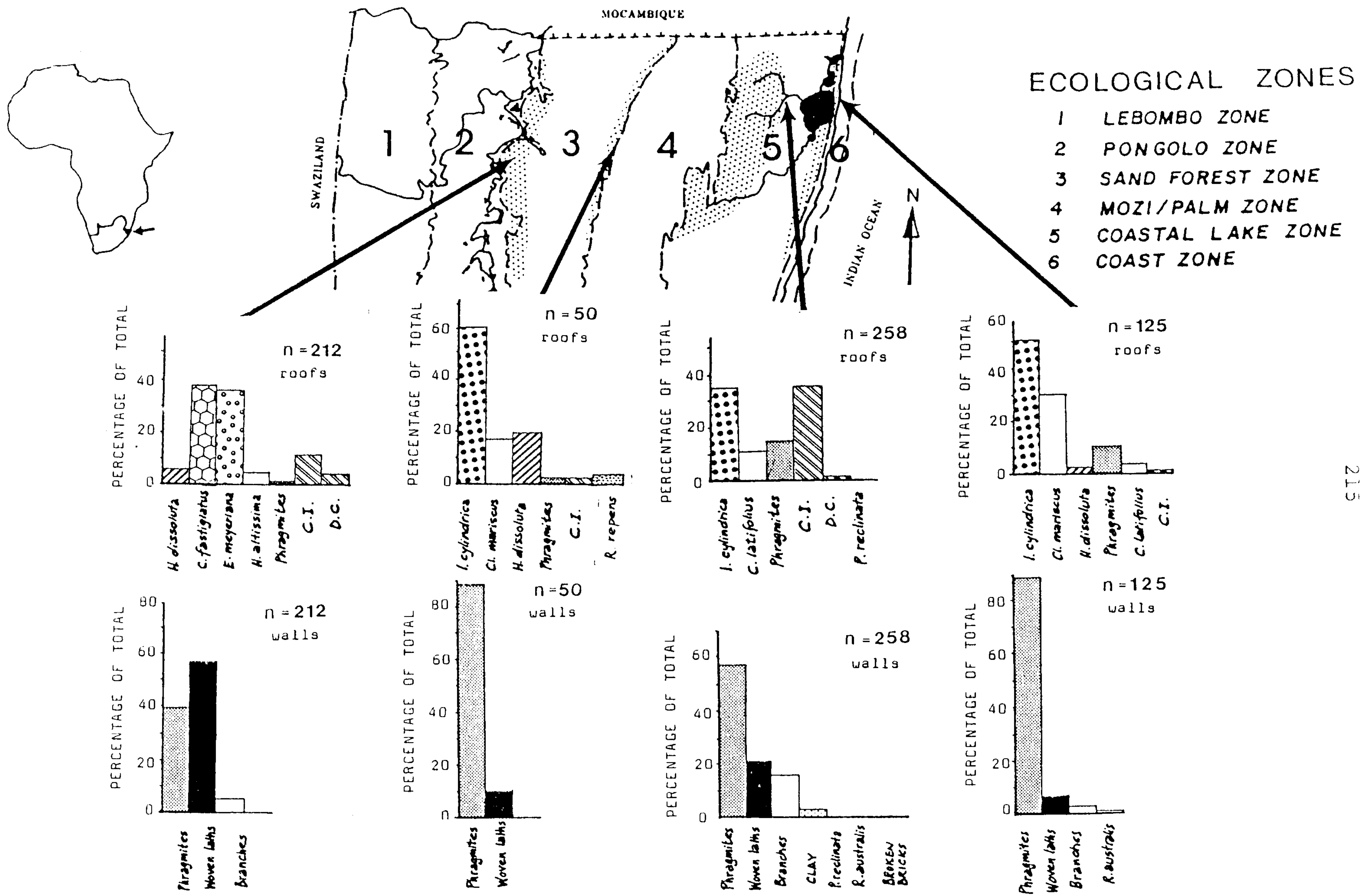


Figure 6. Location of the study area showing extent of use of hut building materials (roofing and walls) according to ecological zones. Shading shows sampled areas. Roofing (upper histograms)

Table 4. Three durability classes for thatching materials used in the study area and their frequency in a sample of huts (n=645) on the Maputaland coastal plain. The frequency of artificial roofing materials is not shown. No huts in the sample were thatched with *Cymbopogon* (*C.excavatus* and *C.validus*) thatch, which would fall into the most durable thatch class.

DURABILITY	SPECIES	NO. IN SAMPLE	TOTAL IN DURABILITY CLASS	PERCENTAGE OF TOTAL HUTS
SHORT (<3 years)	I.cylindrica	193	206	31.9
	H.altissima	9		
	R.repens	4		
MEDIUM (4-6 yrs)	C.fastigiatus	79	189	29.3
	E.meyeriana	76		
	C.latifolius	34		
LONG (7-15 yrs)*	Cl.mariscus	45.5	118.7	18.4
	H.dissoluta	53		
	Phragmites spp	20.2		

Table 5. Wall building materials used in the various ecological zones of the study area.

ZONE	n	REEDS	LATH WOVEN (uphico)	BRANCHES	Phoenix	Raphia	BRICKS	CLAY
SAND FOREST	212	83	118	11	-	-	-	-
MOSI-PALM	50	45	5	-	-	-	-	-
COASTAL LAKE	258	151	53	41	1	1	2	9
COAST	125	112	9	3	-	1	-	-
TOTAL	645	391	185	55	1	2	2	9

THE "TYPICAL" HUT UNITS

The total annual use of plant materials for building purposes was estimated from the KwaZulu Department of Health hut count data using a "typical" hut as a unit and taking the durability of the hut building materials into account.

Eighty percent (m=514) of the huts in the sample (n=645) were thatched. Eighty-nine percent of the walls were either constructed of reeds (60.6%; m = 391) or woven laths (28.7%; m = 185) (Table 5). During the period 1974 - 1983 Department of Health hut counts in the study area showed an increase of 4541 huts, an average of 504,5 huts $year^{-1}$. Based on the dimensions of huts encountered in the study area, a "typical" hut was assumed to belong to one of two types: either a hut with circular plan approximately four metres in diameter, or a hut with a rectangular plan three metres wide by five metres long. The quantity and estimated durability of the plant materials used in constructing these two types of "typical" huts are shown in Table 6. No estimates could be made of the grass, bark rope or forest creepers used, although large quantities were collected (Figure 7). Lath-woven walls used the most wood, followed by wood use for the supporting poles and roof framework (Table 6). A wide range of tree and shrub species were used (Figure 8 and Cunningham and Gwala, in prep). However, extent of use depended on the local abundance of hardwood species. For example, five locally abundant understorey shrub species

Table 6. The quantitites of plant materials used in building the frame, roof and two main wall types (reeds and lath binding or uPhico lath weaving) of a "typical" hut unit.

USE	MATERIAL	TYPE	MASS ($\bar{x}$)	SE (S)	n	NUMBER USED	MAX. MASS PER UNIT	DURABILITY (YEARS)	PROPORTION:
FRAME	Support poles[1]	Wood	21.0	± 5.0	12	8-14	231	20-30	1.00
	Roofing poles	Wood	9.5	± 1.9	20	10-14	114	15-20	1.00
	Roofing laths	Wood	22.0	± 5.0	30	4 bundles	88	15-20	1.00
ROOF	Thatch	grass	13.8	± 3.8	20	20 bundles	276	1-3	.64
	Thatch	grass	13.8	± 3.8	20	20 bundles	276	4-6	.08
	Thatch	grass	13.8	± 3.8	20	20 bundles	276	7-15	.08
	Corrugated iron	-	-	-	-	-	-	-	.20
WALLS	Phragmites	Reeds	13.6	± 3.2	110	15	204	8-12 *	.61
	Lath binding	Wood	9.8	± 4.0	14	10	98	15-20	.61
	uPhico	Wood	22.0	± 5.0	30	90 bundles	1980	15-20	.37
	Other	-	-	-	-	-	-	-	.02

[1]This would vary considerably with the density of the wood used and would be much higher if Combretum, Cleistanthus or Newtonia poles were used.

* Although local hut builders estimated reed wall durability to be 15-20 years, and a few reed walled huts considerably older than this were seen, a figure of 8-12 years is used here due to observation of the more rapid deterioration of most reed walled huts seen in the field.

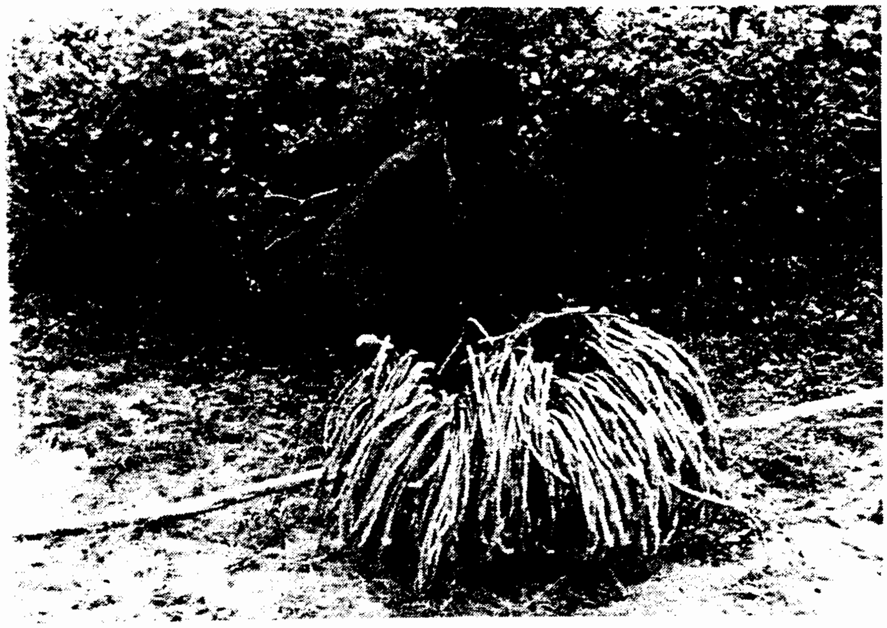
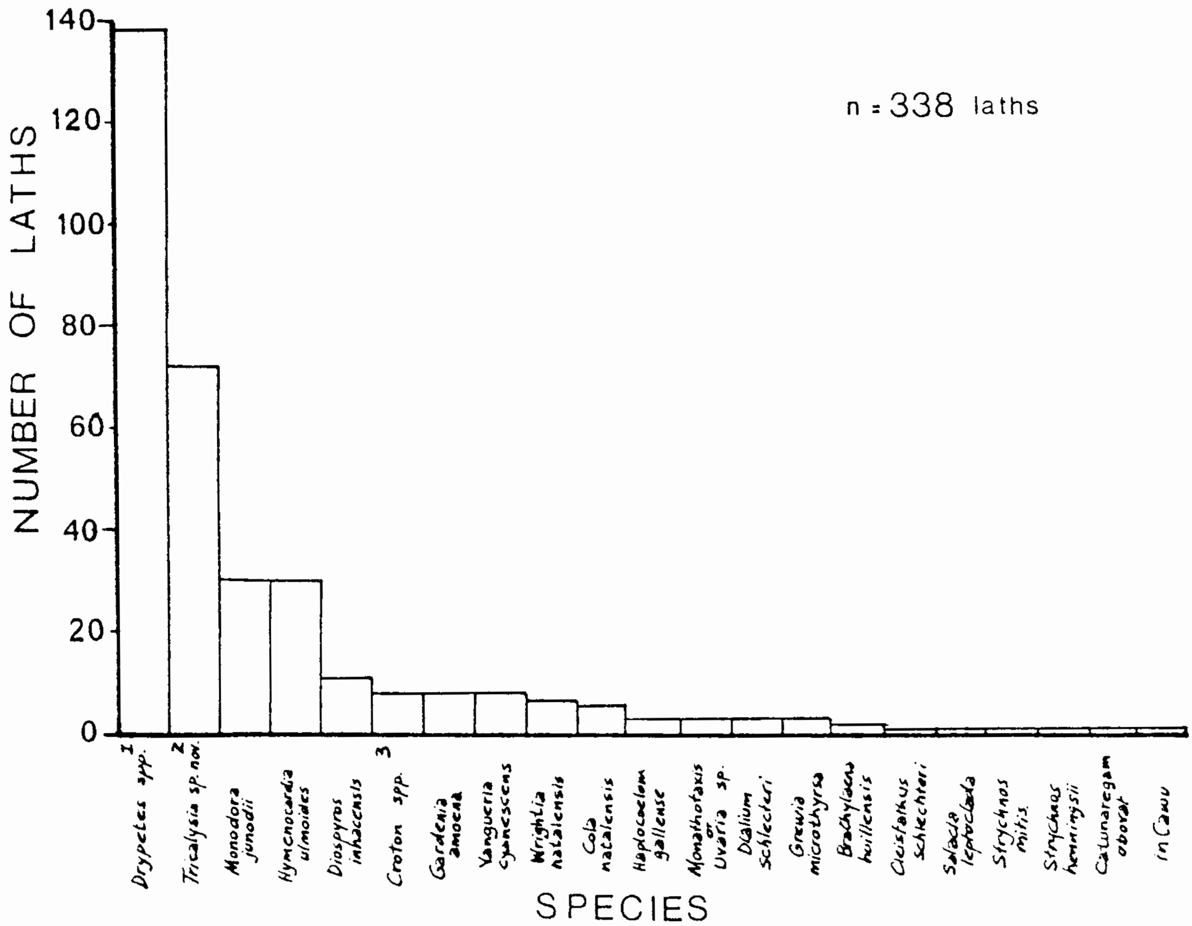


Figure 7. Forest creepers (Monanthotaxis caffra and Landolphia kirkii) collected for use in hut building in the Coastal Lake Zone (October 1980).



Note: 1 = Drypetes species (D. arguta & D. natalensis) indistinguishable and therefore combined.
2 = Tricalysia sp. nov. (Tinley, 447, 885 NH ; M. Ward 764 NH).
3 = includes three Croton species (C. pseudopulchellus, C. steenkampiana, C. gratissimus).

Figure 8. Wood species from Sand Forest/Thicket selectively cut for making lath-woven (uPhico) hut walls in the Sand Forest Zone (June 1982).

(Drypetes arguta, D. natalensis, Monodora junodii, Hymenocardia ulmoides and Tricalysia sp. nov*) dominated 80% (m=270) of a sample of laths (n=338) in the Sand Forest Zone where most of the lath weaving took place (Figure 6).

CURRENT USE

In order to assess the relative pressures on plant resources resulting from human activity or intervention, it is necessary to quantify the effects of those pressures. Hut building plant-use was quantified under three types of material; thatch (T), reeds (R) and wood (W).

The formulae used to estimate the mean quantity of each type of hut building material, and the variance of the estimated means were:

$$E_M = \sum_{i=1}^{k} P_i \frac{m_i x_i}{d_i} \quad \text{and} \quad S^2 = \sum_{i=1}^{k} P_i^2 \frac{m_i s_i^2}{n_i d_i^2}$$

respectively. In these formulae

M = variable suffix indicating material (T, R, or W)

i = variable suffix indicating category i in material M

k = number of categories in material M (3, 1 or 5 for T, R, or W)

E_M = estimated quantity of material M, hut $^{-1}$ year^{-1} (in Kg)

S_m^2 = estimated variance of E_M

P_i = proportion of huts using category i in material M

d_i = durability of category i in material M (in years)

m_i = assumed number of units of category in material M

(* Tinley NH 427; Ward NH 764)

n_i = sample size for category i in material M

$\bar{x}_i$ = sample mean mass of n_i units of category i (in kg^2)

s_i^2 = sample variance of mass in n_i units of category i (in kg^2)

These formulae involved certain simplifying assumptions that need to be specified before use of the formulae may be justified:

a) samples of size n_i taken in the field are assumed to be random samples, yielding $\overline{x_i}$ and s_i^2

b) in the absence of specific proportions for huts of the two typical shapes no allowance is made for associated differences in quantities.

c) the quantities P_i, d_i and m_i are assumed to be fixed and known.

There is no guarantee of the randomness of the samples, though it was considered the samples studied were representative, and not the subject of conscious selection. We therefore treat the samples as though they were demonstrably random.

The two hut shapes differ in roof area ($15.0m^2$ vs $12.6m^2$) and in perimeter wall length (16.0m vs 12.6m), so that plant material used in these elements would differ proportionately in the same way that Liengme (1983) found for Tsonga huts. The final estimates of material derived may therefore be correspondingly inflated or deflated. However, such errors will be minimal in the sense that they will not effect the comparison of plant use in hut building with that in other activities.

The average number m_i of units of a category used in a house is strictly speaking a random variable, and is dependent upon the sizes of the units. It was therefore presumed that the estimates given by local hut-builders may be taken as single fixed accurate counts. This does not appear unreasonable in view of the preponderance of the two typical hut shapes, but assumes that the single count reflects the proportions of the two hut shapes, as well as their individual requirements.

The proportions P_i have also been assumed fixed, and constant across the two hut-shapes. Clearly these P_i may change over time and place. We assume the values used as representative of the study area for the study period and the foreseeable future.

The durability measures d_i are also strictly speaking random variables. They are also assumed to be fixed and known values. The manner in which d_i is incorporated into the S_M^2 formula reflects continuous replacement of decaying material. Where whole units of material have to be replaced as decay occurs, the variation in annual requirements per hut increases, though the average quantity required annually per hut is constant. In such cases, ${d_i}^2$ in S_M^2 should be replaced by d_i, yielding correspondingly increased variance estimates. In what follows we indicate these increased variance estimates with the corresponding lower case suffixes $S^2{}_t$, $S^2{}_y$, $S^2{}_w$.

We may therefore examine the estimates and the 95% confidence intervals for the mean quantities per hut per year, for each type of plant resource, based upon the values given in Table 5 for the terms in the formulae, and upon the well-known 95% confidence interval expression $E_M \pm (1.96)S_M$.

The corresponding intervals for total use of indigenous material would then be presented as:

Thatch

$E_T = 88.32 + 4,.42 + 2.00 \quad = 94.74$

$s_T^2 = 1.4786 + 0.0036 + 0.0008 = 1.4830 = (1.218)^2$

$s_t^2 = 2.9573 + 0.0185 + 0.0084 = 2.9842 + (1.727)^2$

Assuming constant replacement fractions:

95% confidence interval: $94.74 \pm 1.96\ (1.218)$

(92.35; 97.13) Kg

Assuming random replacement of whole units:

95% confidence interval: $94.74 \pm 1.96\ (1.727)$

(91.36; 98.12) Kg

Reeds

$E_R = 12.44$

$s_R^2 = 0.0052 = (0.072)^2$

$s_r^2 = 0.0091 = (0.095)^2$

Assuming constant replacement fractions:

95% confidence interval: $12.44 \pm 1.96\ (0.072)$

$(12.30;\ \ 12.58)$ Kg

Assuming random replacement of whole units:

95% confidence interval: $12.44 \pm 1.96\ (0.095)$

$(12.25;\ \ 12.63)$ Kg

<u>Wood</u>

$$E_W = 9.24 + 6.51 + 5.03 + 3.42 + 41.86 = 66.06$$

$$S^2{}_W = 0.0367 + 0.0071 + 0.0109 + 0.0139 + 0.2177 = 0.2863$$

$$= (0.535)^2$$

$$S^2{}_w = 0.9167 + 0.0651 + 0.1905 + 0.6531 + 3.8095 = 5.6349$$

$$= (2.374)^2$$

Assuming constant replacement fractions:

95% confidence interval: $66.06 \pm 1.96\ (0.535)$

$(65.01;\ \ 67.11)$ Kg

Assuming random replacement of whole units:

95% confidence interval: $66.06 \pm 1.96\ (2.374)$

$(61.41;\ \ 70.71)$ Kg

These figures may be used to predict the total annual demand for each of the materials for repairing or replacing existing shelters, given the presumed number of huts.

In view of the differing durability of materials, these figures are likely to underestimate the quantities of more durable material required for new shelters resulting from increase in population size. For the same reason they are also likely to overestimate quantities of more durable material required to replace decayed material. We illustrate an aspect of this problem within the following section.

FUTURE DEMAND FOR PHRAGMITES REEDS

In calculating future demand for hut building, two measures are of interest. Firstly, the absolute amount used and secondly, the rate of increase in amount used. If certain simplifying assumptions are made, the rate of increase in amount used can be presumed equal to the rate of population increase. These assumptions are that:

i) population growth rate within the period of study has been and remains constant,

ii) the average number of people per indigenous shelter remains constant

iii) the proportion of indigenous shelters within the total number of shelters remains constant and,

iv) the proportions of plant materials used in shelters does not change over time, unless the available sources of a plant material are exhausted.

Thus, if an annual population growth rate of p percent is expected, under these assumptions the demand for reeds could be expected to reflect at least that p percent increase annually. However, the durability of plant materials varies. To calculate the proportion of existing plant material which has deteriorated and needs replacing, the annual factor for increase in material associated with new shelters was taken as s, where

$$s = \frac{(100 + p)}{100}$$

If the plant material is durable for k years, the relative growth in quantity could be considered:

YEARS	0	1	2	3	.... k
FACTOR	1	s	s^2	s^3	.... s^k

The proportion of the material due for replacement is then q, where:

$$q = \frac{(s - 1)}{(s^k - 1)} = \frac{\text{amount about to turn k years old}}{\text{amount increase since time = 0}}$$

This quantity q is in general smaller than $^1/_k$ when plant durability exceeds one year. It reflects the fact that for an annually increasing number of huts, the proportion of newer huts is greater than the proportion of older huts.

The proportion of existing material required for the increase in population is (s - 1), so that the demand r may be written as a proportion of the material already in use, namely

$$r = q + (s - 1) = \frac{s^k\ (S - 1)}{(s^k - 1)}$$

To illustrate the effect of the formula, some values of r are tabulated below:

r	k=½	k=1	k=2	k=5	k=15
p=0	2.0000	1.00	0.5000	0.20000	0.066666
p=2	2.0300	1.02	0.5150	0.2122	0.077825
p=3	2.0489	1.03	0.5226	0.2184	0.083767

Thus, if population was constant and a material lasted six months, 2.000 times the amount currently in use would be required annually, whereas for a material lasting 5 years, the demand would equal one fifth (0.200) of the current use. Similarly, for plant material lasting a single year, the demand increases exactly as population/hut number increases.

If there are the equivalent of 10 000 bundles of a plant material with life 5 years, in use in existing huts, then when the annual population growth rate is 3%, some 2 184 bundles would be required for the following year. At the end of that year, there will be the equivalent of 10 300 bundles in use, and approximately 1 884 bundles will have replaced decayed material since:

USE + DEMAND = NEXT USE + REPLACEMENTS.

However, all four of these quantities increase at the annual rate of p percent.

The increase in hut numbers was 4.37% per annum. Thus the annual demand fraction for <u>Phragmites</u> may be calculated. For $s = 1.0437$, and

	$k = 8$	$q = 0.1508$
	$k = 10$	$q = 0.1256$
or	$k = 12$	$q = 0.1089$

This means that under the assumptions stated, the current sales of 19 106 <u>Phragmites</u> bundles in the study area represents between 10.9% and 15.1% of the total amount of <u>Phragmites</u> in use. However, these sales figures are likely to increase annually at the 4.37% rate. If the 178 ha of reed suitable for harvesting (135 ha in the Tembe Elephant Reserve zoned for cutting; 43 ha outside the reserve near Muzi) yield 500 bundles per hectare (see discussion below and Veber, 1978) the demand could be expected to be met for a further 35.97 years, since

$$\frac{178 \times 500}{19\ 106} = 4.6582 = (1.0437)^{35.97}$$

or equivalently until the hut number in the study area has increased by a factor of 4.6582. If the adverse effects of harvesting (eg. disturbance to wildlife; nutrient depletion) require that harvesting in the 135 ha reed cutting area of the Tembe Elephant Reserve is biennial rather than annual, the reduced crop will sustain the assumed growth for only 24.8 years.

The figure of 500 bundles per hectare represents a yield of 6.8 tons of leaf stripped stems per hectare. This figure is purposely conservative due to the need for more data on the effects of harvesting and the nutrient and other requirements for sustainable yield. Yield of leaf-stripped reeds from Mosi drainage could be between 20 - 30 tons per hectare (Wrigley, pers comm, 1983*). More data is therefore required on reed yield and the effects of harvesting to update this conservative estimate (Cunningham, in prep a) and consequently the time limit demands for reeds equals sustainable yield.

From Table 6, at approximately 15 reed bundles per hut, the number of huts using this material could be estimated as being between

$$\frac{19\ 106}{15} \times \frac{10\ 000}{1\ 508} \quad \text{and} \quad \frac{19\ 106}{15} \times \frac{10\ 000}{1\ 089}$$

ie. 8 446 and 11 696

*T Wrigley
Institute for Environmental Sciences
University of the Orange Free State
BLOEMFONTEIN 9300

on the assumption that the sales figure covered all sources of reeds. We may therefore seek to obtain independent corroboration of the validity of the assumptions. Since from Table 5, 61% of the huts use _Phragmites_, and since the sales records (Cunningham, in prep a) indicate that 19.69% of the reeds were sold for use outside the study area, the derived hut numbers can be adjusted by a factor of 1.316 = (80.31 ÷ 61.00). The resulting figures imply between 11 120 and 15 398 huts in the study area.

Some underestimation may result from the fact that not all reed use was commercial. Approximately 2587 huts in the study area were built close to _Phragmites_ wetlands along the Mosi drainage (Health Department sub-units M1, M4, M5; S3, 4, 6, 8, 10) and around the Kosi area (Health Department sub-units BH1-4; KB 2-4; MP 1-10) (see Appendix I). Most of these people cut reeds for their own purposes rather than bought them. The proportion of huts using reeds in these areas was estimated as 89%, while in the Coastal Lake Zone it was 56% (Figure 6). Revised limits could therefore be obtained by adjusting the figures by a factor of 1.089 = (61.0 ÷ 56.0) and adding 2587. On this basis it would be argued that there are between 14 699 and 19 948 huts in the area, in comparison with the official counts of 14 200 reported in Table 2.

The accuracy of the hut counts is not in question, though it is possible that undercounting occurs as indicated in Table 3.

It is clear that the analysis is not grossly inconsistent, although not altogether satisfactory. Other assumed values for:

(i) the durability of Phragmites

(ii) the quantities required for building a hut, and

(iii) the actual rate of increase in hut numbers

might produce ranges that included the official figure of 14 200. Even moderate increases in the estimated quantity per hut produce the desired consistency, eg. from 15 bundles to 16 bundles implies the range from 13 780 to 18 701. It is therefore concluded that numerical aspects of this analysis may be usefully applied in decisions on related issues of conservation policy.

DISCUSSION

Housing is a basic need. In Maputaland indigenous plant resources are currently playing the major role in filling this need. Therefore if the shortage of building materials experienced elsewhere (Fleuret, 1980; Frescura, 1981) is to be avoided, it is necessary to see the question of housing in perspective before indigenous plant resources used for building purposes can be effectively managed.

In common with Maputaland as a whole, the Ingwavuma district has experienced a rapid increase in population over the past fifty years (Figure 9). The increase in hut number over the past nine years (1974-1983) and probably prior to this, has been even faster. The quinquennial rate of population growth is 14.1%, about 2,67% per annum (Thorrington-Smith et al, 1978). Between 1974 and 1983 the quinquennial rate in hut number was 23.87% which is the equivalent annual increase of a 4.37% or an average of 504.5 huts per annum. The higher rate for huts may possibly be partly due to a tendency to build a homestead and then move to a new site within a relatively short space of time, perhaps because of low soil fertility. (Note: this means empty huts or abandoned huts were counted into the total or that household size is diminishing).

These increases in population and hut number have not been evenly spread over the entire area. Sites with schools, stores

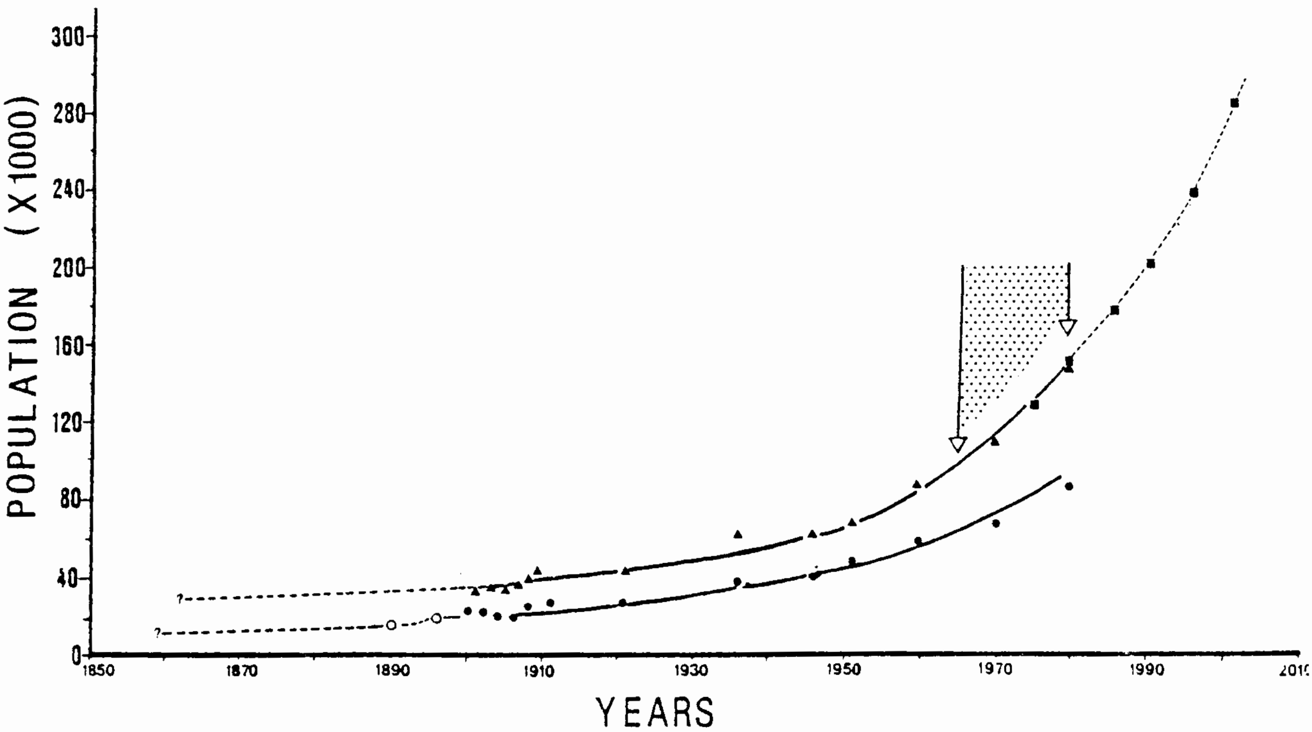


Figure 9. The estimated, actual or projected growth of the population of Maputaland (1900-2000) (upper curve) and the Ingwavuma district (1900-1980) (lower curve) from Cunningham, 1985. The period 1964-1983 for which hut numbers are presented is indicated between the two arrows in the figure.

and clinics have been foci of settlement. Most problems facing sustainable use of plant resources are therefore not in outlying areas but are concentrated at these sites. Against the background of the large scale migration of rural peasants to urban areas (Thorrington-Smith et al, 1978) that started in Maputaland in about 1873 (evidence of Mahungane and Nkomuza, in Webb and Wright, 1979) has been the small scale local migration to specific foci of settlement. At the local level, increases in population and hut number were slower at well established sites (eg. Ndumu, KwaNgwanase) than at their peripheri. For example during the period 1974-1983 the hut number at KwaNgwanase increased by 45% (an average of 70.7 huts per year) whilst at Zangomeni, on the outskirts of KwaNgwanase, there was a 375% increase in hut number (106 huts per year) (Table 1). From these data on local hut building trends coupled with field records a number of generalisations could be inferred:

1) Increased pressure on plant resources, including those used for hut building. Firstly, due to clearing of forest and thicket for agriculture. Secondly, the influx of livestock into forest and thicket, with subsequent destruction of the understorey through trampling and heavy browsing. Thirdly, loss of thatch supplies in the surrounding communal grazing lands due to uncontrolled burning.

2) Increased effects of cattle grazing and trampling, burning and intensive cutting of <u>Phragmites</u> wetlands (Furness and

Breen, 1980) and exclusive uprooting of <u>Cyperus</u> <u>fastigiatus</u> rhizomes by pigs on the Pongolo floodplain during dry season periods.

3) Development of commercial trade in tall <u>Phragmites</u> reeds to supply the demand for building material at these sites. Firstly, because of the suitability of reeds for construction and secondly, because of the time-consuming nature of lath weaving (Cunningham, in prep a).

4) From data in Table 1 it could also be assumed that the size of plots allocated by the headmen in these areas and the length of fallow periods in agricultural plots was decreasing with a corresponding decrease in soil fertility and plant productivity, and a resultant increase in dependence on the cash economy.

The three basic categories of hut building resources (thatch, reeds and wood) varied in their availability, the seral stage of the vegetation from which they were collected, and their extent of use for other purposes (eg. firewood). Thatch grass and reeds, collected from almost mono-specific stands, had a high biomass and productivity and were usually rhizomatous species with high above ground production. These factors facilitated their harvesting and availability. This was not the case with indigenous woody species suitable for hut building where straight poles or laths had to be selectively cut. Also while the only significant use made of mature thatch and reeds was for building purposes, wood was also required for fuel, fish kraals and fencing.

THATCH

There is little doubt about the abundance of thatch and its ability to meet increased demand, even if the selective use of tall stands of thatch grass species was taken into account. These factors were common to thatch grasses from disturbed areas (eg. Imperata cylindrica and Hyperthelia dissoluta), savanna (eg. H.dissoluta) and wetlands (eg. Cyperus latifolius and C.fastigiatus). The production of H.dissoluta - Heteropogon contortus grassland can exceed 2000 kg $ha^{-1}yr^{-1}$ (Smith, 1963). In an area of Zaire with a similar rainfall to the study area (860 mm), I.cylindrica grassland productivity was 1750 kg ha^{-1} yr^{-1} (Bouliere and Hadley, 1970). Echinochloa phyramidalis wetland in Malawi was reported to have an average annual production of 5370 kg $ha^{-1}yr^{-1}$ (Thomas, pers comm to Rutherford, 1978). Thatch was collected mainly from fallow fields or seasonally flooded wetlands (H.dissoluta and I.cylindrica). Even at densely settled sites, thatch was abundant if fires were controlled. At KwaNgwanase for example (18.8 huts km^{-2}) there was an annual surplus of H.dissoluta available. This was cut and sold on a small scale when improved road infrastructure provided access to a local market within the region (1983). The situation with Phragmites reeds and wood (poles and laths) was different.

REEDS

Tall reeds for hut walls, although a productive annual "crop", were not abundant close to densely settled sites. Consequently a system of commercial harvesting and sale was established by rural people on local initiative to supply the demand at these sites, with an estimated 260 tons of reeds cut annually (Cunningham, in prep a). However, to reduce conflict with other uses of wetlands (conservation/tourism at elephant drinking sites) only 135 ha of <u>P.australis</u> wetland were zoned for reed harvesting (Cunningham in prep a).

Due to the effects of nutrient supply, water quality and supply on growth, (Haslam, 1970; Dykyjova and Hradecka, 1976), tall reeds suitable for hut building are limited to permanently flooded wetlands. In such areas, <u>P.australis</u> biomass and productivity is high, with a biomass of 60-70 tons ha^{-1} recorded for Lake Tchad and an even higher biomass recorded in Europe for sites with high nutrient status (Leveque, 1972 in Dykyjova and Hradecka, 1976). However, the area of reeds available in the study area was limited (Cunningham, in prep a) and the yield of reeds suitable for building material can be expected to fluctuate (yields of commercial reed bundles cut from <u>P.australis</u> stands in temperate wetlands (Czechoslovakia) fluctuated from year to year between 350 and 1000 commercial bundles per hectare (Veber, 1978)).

HARDWOOD POLES AND LATHS

While reeds are limited to specific sites, they have not been threatened by hydrological disturbance or agricultural requirements (eg. rice cultivation) until recently. In contrast to Phragmites wetlands on the coastal plain, whose area of cover has remained relatively constant since the 1942 aerial photograph series, the area of forest has declined rapidly. This decline has corresponded to an increase in the availability of thatch in fallow fields and a decrease in the supply of building poles and laths.

Forests and tall thicket were the most important sources of straight hardwood poles and laths. This fact was well known to early colonists and foresters in South Africa. Although perceptive individuals acknowledged that agricultural clearing was the major threat to forests in Natal, the cutting of laths and poles for hut building by Zulu people was seen as a major threat (Colony of Natal, 1889; Storr-Lister, 1902). The primary reason for this was that cutting of hut building material conflicted with the colonists requirements for building timber. Both groups required hardwood species that were termite resistant and durable. Each group selected particular size classes of straight hardwood trees. Sawyers selected large trees for planking (Colony of Natal, 1889; Sim, 1907) whilst hut builders selected thin laths and small trees. P H Zeitsman, for example, admitted to the Commission on Forest Lands in the Natal Colony that "the natives have not, to my knowledge, cut down any large trees, they have been very destructive to young timber for the purpose of building their huts and annually repairing their cattle kraals" (Colony of Natal, 1889). The problem was therefore this conflict of uses. Apodytes dimidiata, Buxus macowanii, Ochna arborea, Ptaeroxylon obliquum, Podocarpus latifolius, P.henkelii, P.falcatus, and Zanthoxylum capense for example, were all considered to be economically important trees in the Cape Colony (Sim, 1907) and were or still commonly used for hut building (Colony of Natal, 1889; Johnson, 1982; Cunningham and Gwala, in prep).

The result was that almost all large forests were proclaimed as "Crown Forest" and "natives were punished if they cut saplings of reserved trees, and had to take wattles from inferior scrub or underbrush" (Storr-Lister, 1902). Although planting of woodlots was first proposed to the Forest Department in 1890 and was clearly a viable alternative to forest use for building material and firewood cutting (Carlson, 1939), little was subsequently attempted (Gandar, 1983). The priority was rather the sustainable use of forests for timber production (Storr-Lister, 1902). Even less has been done to reduce human pressure on the land and to avoid the greatest threat - that of agricultural clearing. The result has been that of the 250 forests in KwaZulu proclaimed since 1936, only 50 remain in a good condition (Department of Agriculture and Forestry, 1981` Much the same situation applies in Maputaland. The Buhlungwin umGungu and Makongolo forests near Lake Sibaya, for example, that can clearly be seen on the 1942 aerial photographs are today represented by patches and a scattering of outlying fruit bearing tree species (eg. Manilkara discolor).

From a preliminary survey of the intensity and effects of cutting of poles and laths in the Manguzi-Mabibi Forest near KwaNgwanase, it appeared that selective use was made of straight poles and laths, most of which recoppiced after cutting (Cunningham, 1983). From the data on annual use of wood per hut, wood use for building in the study area was low, firstly, because of the durability of the hardwoods and secondly, due to the popularity of reeds for hut walls. Even if a higher wood consumption figure (230 kg $family^{-1}$ $year^{-1}$ (Liengme, 1983) is taken into account, there is little doubt that the effects of wood use on forests in the study area were minimal (Table 7). Yet the restrictions of colonial legislation are reflected in current nature conservation and forestry policy. The cutting of wood for hut building material and fuel are, at worst, merely the final nail in the coffin of large forests reduced to remnants by a combination of planking by commercial sawyers, agriculture, fire and heavy browsing by livestock.

Woodlots and pole depots can provide a valuable interim solution to take the pressure off small forest remnants in densely populated areas. The KwaZulu Department of Forestry for example, sold over 29 000 laths and 9 000 poles (mainly of the exotic Eucalyptus grandis) during a ten month period (October

Table 7. Comparison of wood consumption for hut-building, fuelwood and commercial craftwork in the study area with data from other studies.

CATEGORY	VEGETATION TYPE	tons cap $^{-1}$ year^{-1}	tons family^{-1} year^{-1}	ESTIMATED TOTAL : STUDY AREA (tons/year)	SOURCE
FUELWOOD	High grassland	0.62			Gandar (1983)
	Valley low-veld	0.74			Gandar (1983)
	Valley low-veld	1.12			Best (1979)
	Mopane veld	-	5.4	60 700 (2)	Liengme (1983)
			7.7		Gandar (1981)
	Coast forest and savanna	0.53	1.8 - 4.1 (1)		Cunningham, unpublished
	Acacia-Terminalia savanna	0.26 - 0.35			Jelenic and van Vegten (1981)
HUT BUILDING					
Tsonga	Mopane veld	-	0.23	-	Liengme (1983)
Tembe-Thonga	Coast forest and savannah	-	0.16 - 0.18 (3)	1946	This study
COMMERCIAL CRAFTWORK	Coast forest and savannah	-	-	1.18	Cunningham (in prep c)
BRUSHWOOD FENCING	Valley lowveld	-	0.26 (4)	-	Gandar (1984)

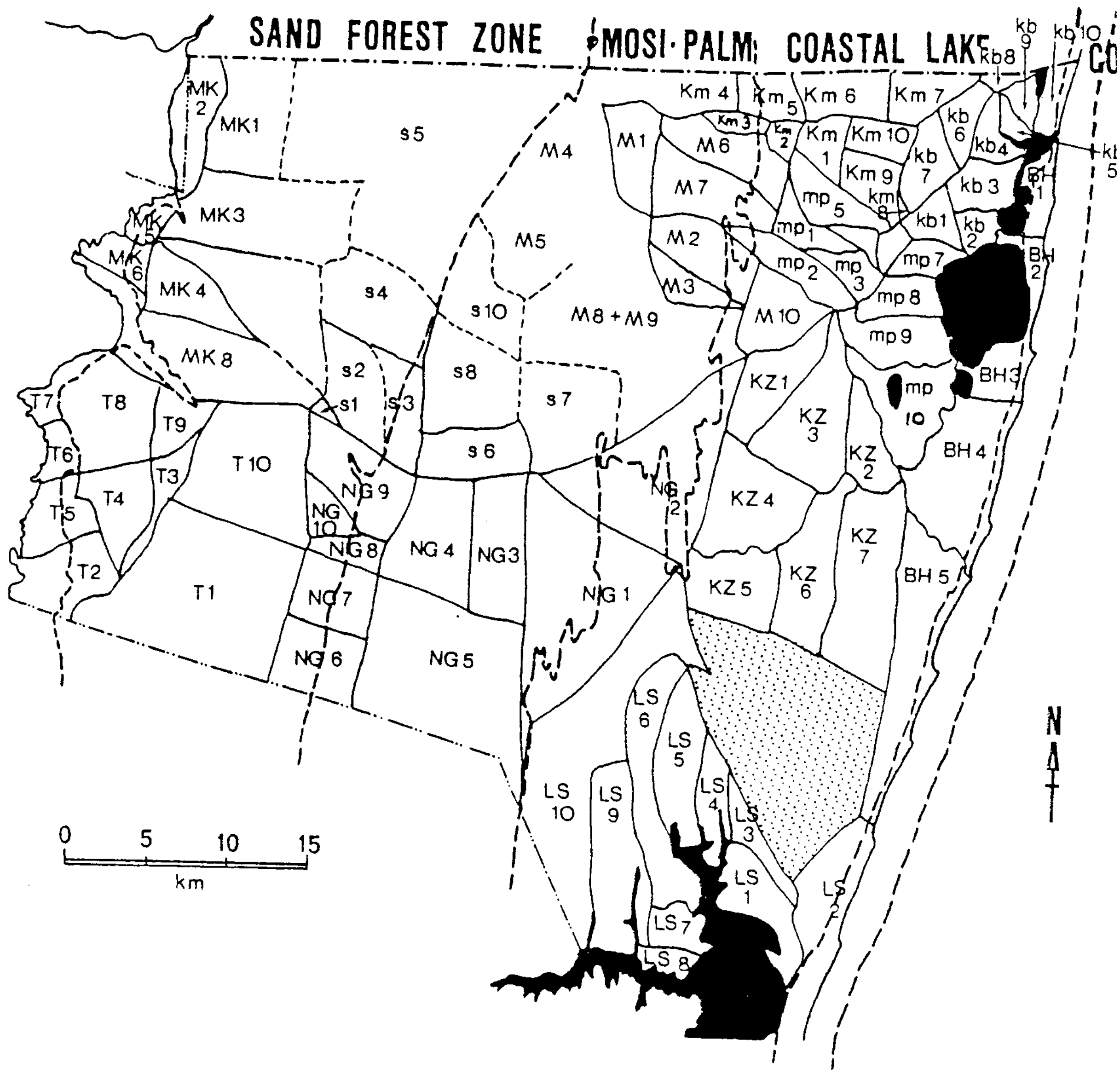
(1) Included to show extent of variation in firewood consumption

(2) Estimated on a basis of 5 tons family yr^{-1}

(3) Estimated on the basis of 2.61 huts per kraal (KwaZulu Department of Health, 1983)

(4) Brushwood fencing is comparatively uncommon on the coastal plain although frequent along the Pongolo floodplain and elsewhere in KwaZulu

1979 - July 1980), at KwaNgwanase with demand for the long, straight poles often exceeding supply. More fuelwood woodlots area also needed in the vicinity of the rapidly growing settled sites. However, the major challenge lies in tackling the most serious threat to forest areas - the dependence of the high density agropastoralists on the land. The need for food, shelter and a modicum of comfort is just as valid and important amongst rural people as it is amongst urban dwellers. Survival of Maputaland's floristically unique forest habitat depends on effective action at the political level that takes into account the extent to which the people of the study area rely on plant resources for their basic needs. Evidence presented here indicates that the plant resources of the area can support hut-building needs for a foreseeable period in the future. Provision of woodlots as an alternative source of fuel is one practical interim solution to wood shortage, but the most significant gains for conservation will follow from alternatives that reduce human pressure on the land. In turn such alternatives require that the people affected are closely involved in initiating and assessing the benefits of such action. Conservation strategies that do not benefit the rural poor and rather result in further restriction on their efforts to survive through use of natural resources, will not succeed in any long term success for in situ conservation of high priority habitat.



Appendix I. The boundaries of the KwaZulu Department of Health malaria spraying sub-units in the study area. Area names of each sub-unit were summarised as follows:

T = Tete pan
Mk = Makhane's Drift
S = Sihangwane
NG = Ngutshana
LS = Lake Sibaya
M = Muzi
Km = KwaMshudu
KZ = KwaZibi
Mp = Maputa (= Kwa Ngwanase)
Kb = Kosi Bay
BH = Bhanga Nek

ACKNOWLEDGEMENTS

We are grateful to the Director, KwaZulu Bureau of Natural Resources for permission allowing one of us (A B C) to collect the data for this study whilst working for the Bureau and to the Tembe Tribal Authority for permission to work in the area under their control. We would also like to acknowledge the invaluable assistance from Mr B R Gwala in the field, Mr S Nqongo and Mr J V Mbamali for help in obtaining the data resulting from malaria control spraying, and comment on the manuscript from Prof E J Moll, Mr C Hilton-Taylor and Miss C A Liengme.

LITERATURE CITED

Best, M G 1979. The consumption of energy for domestic use in three Africa villages. MSc thesis, University of Cape Town.

Boulière, F and M Hadley 1970. The ecology of tropical savannas. Ann Rev Ecol Syst 1:125-152.

Bruton, M N 1980. Conservation and development in Maputaland pp. 497-529 in "Studies on the ecology of Maputaland". M N Bruton and K H Cooper ed Cape and Transvaal Printers, Cape Town.

Carlson, K A 1939. Weaning of the natives from the natural forests in the native territories. J S A Forestry Assoc. 2:75-76.

Colony of Natal 1889. Commission appointed to enquire into and report upon the extent and condition of Forest Lands in the Colony. W M Watson, Government Printer, Pietermaritzburg.

Cunningham, A B 1983. Manguzi Forest Survey. Unpublished report, 19 pp. to KwaZulu Bureau of Natural Resources, Ulundi.

Cunningham, A B in prep a. Commercial harvesting of *Phragmites australis* reeds in a low agricultural potential area.

Cunningham, A B in prep b. Commercial Craftwork : balancing out human needs and resources.

Cunningham, A B 1985. The resource value of indigenous plants to rural people in a low agricultural potential area. Unpublished PhD thesis, University of Cape Town.

Cunningham, A B and Gwala, B R in prep. Building methods and plant species used in Tembe-Thonga hut construction.

Deitz, A G H 1979. Materials in : Low Cost Housing Technology. L J Goodman, R P Pama, E G Tabuhara, R Razani, F J Burzan (eds) Pergamon Press, New York.

Department of Agriculture and Forestry 1981. Proposals towards an environmental plan for KwaZulu. Unpublished report, KwaZulu Department of Agriculture and Forestry, Ulundi.

Dykyjova, D and D Hradecka 1976. Production ecology of Phragmites communis 1. Relations of two ecotypes to the microclimate and nutrient conditions of habitat. Folia Geobot Phytota, Praha 11:23-61.

Fleuret, A 1980. Nonfood uses of plants in Usambara. Econ Bot. 34:320-333.

Frescura, F 1981. Rural shelter in southern Africa; a survey of the architecture, house forms and constructional methods of the black rural peoples of southern Africa. Ravan Press, Johannesburg.

Gandar, M 1981. Tree utilization in KwaZulu. Unpublished progress report, CSIR, Pretoria. (Cited by Liengme, 1983).

Gandar, M V 1983. Wood as a source of fuel in South Africa. Monograph no 4. Institute of Natural Resources, University of Natal, Pietermaritzburg.

Government Gazette 1952. Reservation of Trust Land for forest purposes, Ingwavuma district. Government Notice no 1160. pp. 57. Government Printer, Pretoria.

Haslam, S M 1970. The performance of Phragmites communis Trin in relation to water-supply. Ann Bot. 34:867-877.

Jelenic, N E and J A van Vegten 1981. A pain in the neck: the firewood situation in south-western Kgatleng, Botswana. N I R Research Note No 5. 47 pp. University College of Botswana, Gaborone.

Johnson, C T 1982. The living art of hut building in Transkei. Veld and Flora. 68:109-110.

Knuffel, W E 1973. The Construction of the Bantu Grass Hut. Gras Akademische Druk. 85 pp.

Levéque, C et al 1972. Recherches sur les biomasses et la productivité du Lac Tchad. In : Productivity problems of Freshwater, Warsawa et Krakow. Proceedings of the IBP - UNESCO Symposium. p. 165-181. (Quoted by Dykyjova and Hradecka, 1976).

Liengme, C A 1983. A study of wood use for fuel and building in an area of Gazankulu. Bothalia 14:245-257.

Malan, J S and G L Owen-Smith 1974. The ethno-botany of Kaokoland. Cimebasia (B) 2:131-178.

Rutherford, M C 1978. Primary production ecology in southern Africa. pp. 621-659 in : Biogeography and Ecology of southern Africa. M J A Werger (ed) W Junk, The Hague.

Siegfried, R 1984. Energy conservation in Transkei rural communities. Carnegie Conference paper No. 259. Second Carnegie Inquiry into Poverty and Development in southern Africa.

Sim, T R 1907. The forests and forest flora of the Cape Colony. Taylor and Henderson, Aberdeen.

Smith, C A 1963. Oversowing pasture legumes into the Hyparrhenia grassland of Northern Rhodesia. Nature 200:811-812.

Storr-Lister, J 1902. Report on Forestry in Natal and Zululand. Government report, Colony of Natal. Times Printing and Publishing Co, Ltd, Pietermaritzburg.

Thorrington-Smith, Rosenberg and McCrystal 1978. Towards a plan for KwaZulu. The preliminary development plan. KwaZulu Government, Ulundi.

Veber, K 1978. Propagation, cultivation and exploitation of common need in Czechoslovakia. pp. 417-425 in: Pond littoral ecosystems: structure and functioning. D Dykyjova and J Kvet (eds). Springer-Verlag, New York.

Van Voorthuizen, E G and M Odell 1976. Thatching in Botswana: the socio-ecology of traditional construction. Botswana Notes and Records 8:165-174.

Webb, C de B and J B Wright 1979. The James Stuart Archive of recorded oral evidence relating to the history of the Zulu and neighbouring peoples. Vol II University of Natal Press, Pietermaritzburg.

Whitlow, J R 1979. The household use of woodland resources in rural areas. 24 pp. Natural Resources Board, Zimbabwe.

BUILDING METHODS AND PLANT SPECIES USED IN TEMBE-THONGA HUT CONSTRUCTION

A.B. CUNNINGHAM AND B.R. GWALA

SYNOPSIS

This paper describes the construction of the traditional Tembe-Thonga hut. Plant species used in building the typical and decorated hut types on the Maputaland coastal plain, Natal, South Africa are listed with their Zulu and Thonga names.

INTRODUCTION

Like most of southern Africa, the Maputaland area in Natal, South Africa is changing rapidly. Altered settlement patterns and building styles are symptomatic of the cultural, technological and ecological changes that are taking place. Most of the coastal area is covered by leached sandy soils with low agricultural potential (Maud, 1968, 1980; Loxton et al., 1969). The majority of the areas with moderate to high potential remaining outside forest reserves or conservation areas are under cultivation. In more densely populated areas, shifting agriculture has been replaced by repeated tilling of the same plots. Sites with schools, stores and clinics have become increasingly important as the focus of settlement.

(Department of Botany, University of Cape Town, Rondebosch, 7700 and
P.O. Box 82, KwaNgwanase, 3973)

With this change from a subsistence to a consumer way of life, much of the people's cultural knowledge will be lost unless it is recorded. Pooley (1980) has published a list of plants used in the Maputaland area including hut building materials, but this can be expanded. The edaphic conditions of the sandy coastal plain pose specific problems to the people living there. Apart from the low agricultural potential, there is no rock or clay for building purposes, for making pottery or for grinding food. Use of indigenous vegetation has provided many of the solutions to these problems and is reflected in the excellent botanical knowledge of the Tembe-Thonga people today (Pooley, 1980; Felgate, 1965, 1982). Although Palmer and Pitman (1972) and Coates-Palgrave (1977) record tree species used in hut construction in southern Africa and van Voorthuizen and Odell (1976), Knuffel (1973) and Liengme (1983 a) have respectively identified and quantified the materials used in Tswana, Ngwane and Tsonga hut construction, building styles and the building materials vary with cultural group and environmental conditions.

The aim of this paper is to record hut construction methods and plant species used by the Tembe-Thonga people on the coastal plain. The extent of use of building materials and the increase in hut numbers over the ten year period 1974 - 1983 in this area are recorded elsewhere (Cunningham, in prep. a and b).

METHODS

Information on species used in hut building was collected during a study (1980 - 1984) on the resource value of indigenous vegetation to rural people on the Maputaland coastal plain. One of us (BRG) is from the study area and was already familiar with construction methods. Information on the species used was obtained from local hut-builders study in a similar way to Liengme (1983 b). Plants were identified and voucher specimens were deposited at the Bews Herbarium, Natal University (Cunningham in prep. c). Details of decorative hut construction were obtained from the two last known specialist hut-builders in the area who were both over 70 years old. Through the efforts and interest of Ms P. McLaren[1] these men were employed to build a traditional hut outside the new offices of the Tembe Tribal Authority as an example of the skills and cultural knowledge of the Tembe people[2]. This gave the opportunity for a series of photographs to be taken of decorated hut construction.

1. Ngezandla Zethu, P.O. Box 326, KwaNgwanase, 3973

2. Note: This hut can be viewed by arrangement with the Tembe Tribal Authority. All other huts figured in this paper are private homes and on no account should their owners be disturbed. For this reason no details are given on the locality of the traditional huts.

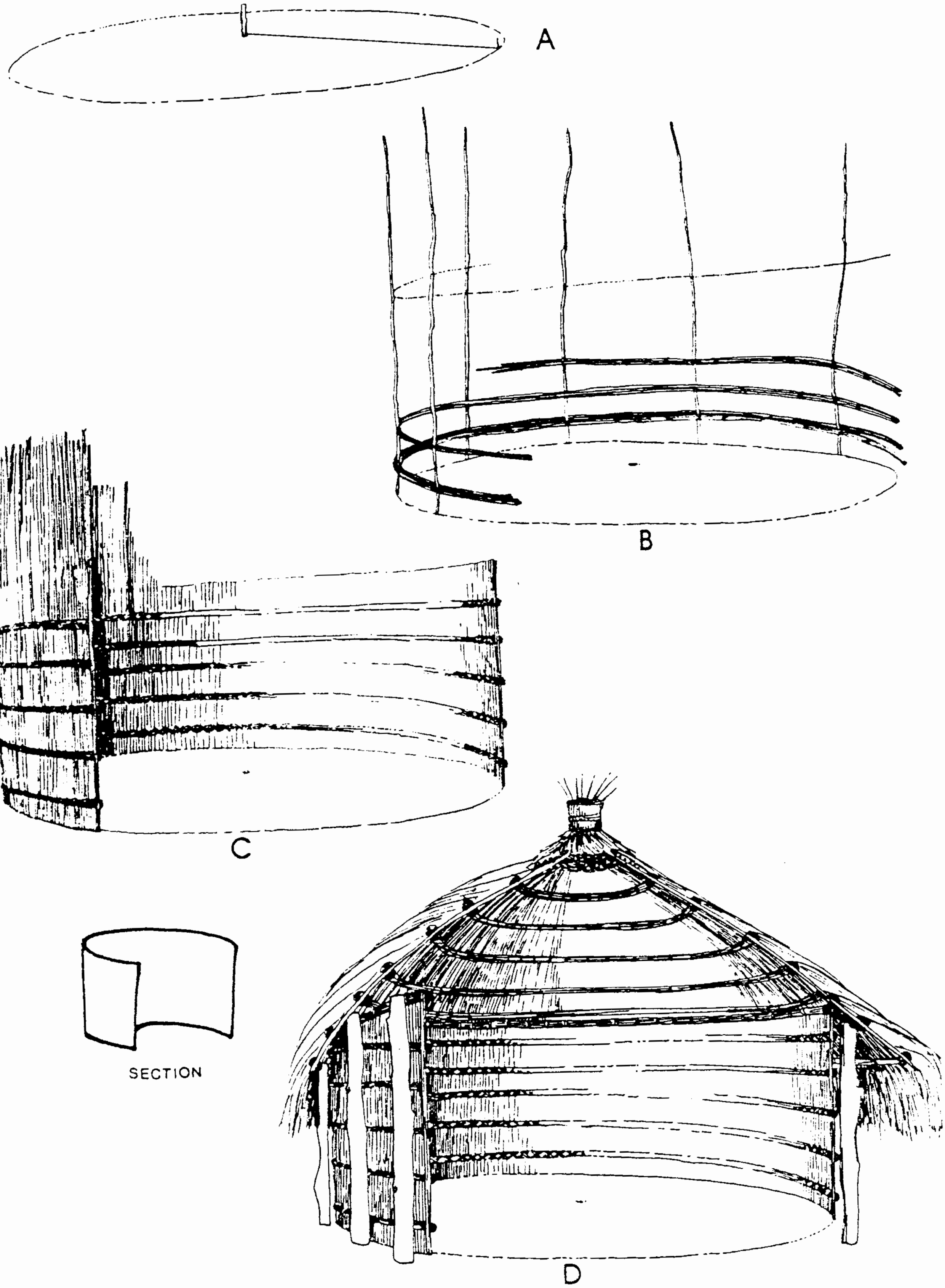


Fig 1 Stages in hut construction. A. Demarcation of the building site for a circular hut with a string attached to a peg in the centre of the site. B. Placing of lath bundles. C. Reeds bound into position and trimmed off at the desired level. D. Completed hut.

Fig 2 Hut viewed from the outside showing the hut builder binding off a few reeds at a time between the inner and outer lath rings.

Fig 3 Interior view of the completed wall of a professionally built hut showing close spacing

HUT CONSTRUCTION

After choosing a site the prospective hut owner gets permission to build from the local headman. Using a string tied to a peg, a circle of the desired hut radius is marked out (Figure 1 a). For a square or rectangular structure, the area is marked out with pegs at each corner. Reed walls are traditionally used for circular huts and lath woven walls for square huts due to the limitations of the straight lath woven panels.

Men are traditional hut builders. Women collect thatch and prepare twine, rope and thatching mats. Due to the necessity of threading binding material back and forth in all phases of construction, building is usually done by a minimum of two men. The walls and roof are built separately. Once the roof structure is complete, the roof framework is lifted onto the walls by a group of helpers and the supporting poles are put in place. Should the owner wish to remove the hut to a different site, the reverse procedure takes place. Both processes are treated as social occasions and beer and palm wine are supplied to people giving assistance.

Wall Building

Thin poles, 3-6 cm in diameter are firmly placed in the sand about 1 metre apart along the circumference of circular hut site. Favoured species used throughout the coastal plain are Hymenocardia ulmoides, Apodytes dimidiata, Mimusops obovata, Ptaeroxylon obliquum, Dialium schlecteri, Terminalia sericea, Drypetes arguta and D.natalensis. Newtonia hildebrandtii, Cleistanthus schlecteri and Pteleopsis myrtifolia are also popular but these species are restricted to Sand forest areas. All are termite resistant hardwoods. These are supported by thinner laths tied together to form a horizontal ring inside the poles (Figure 1 b). More rings of bound laths are added every 20-30 cm. The topmost ring is usually 1,5 - 2 m from the ground. Above this is a plaited string marking the required height of the wall. This is usually plaited from Digitaria eriatha but may be made of other materials (Table 1). A second horizontal ring is then bound in place outside the poles adjacent to the inner ring with the vertical poles acting as a spacer.

Binding is usually done with strips of Hyphaene natalensis leaves. In the coastal area, strips of Hibiscus tiliaceus bark, Strelitzia nicolai petiole or Ficus (F.burtt-davyi or F.trichopoda) bark are also used. These binding materials can all be dried and stored prior to use. On site the builder normally buries them in wetted sand to moisten them and make the binding material more flexible. Phragmites australis or P.mauritianus reeds are placed between the lath rings and are bound into groups of 10-20 reeds. Specialist hut-builders make a stronger hut wall by binding off 3 reeds at a time (Figures 2 and 3). As the reeds are bound in

Fig 4 Plaited string (D.eriantha) marking the height at which the reeds will be trimmed.

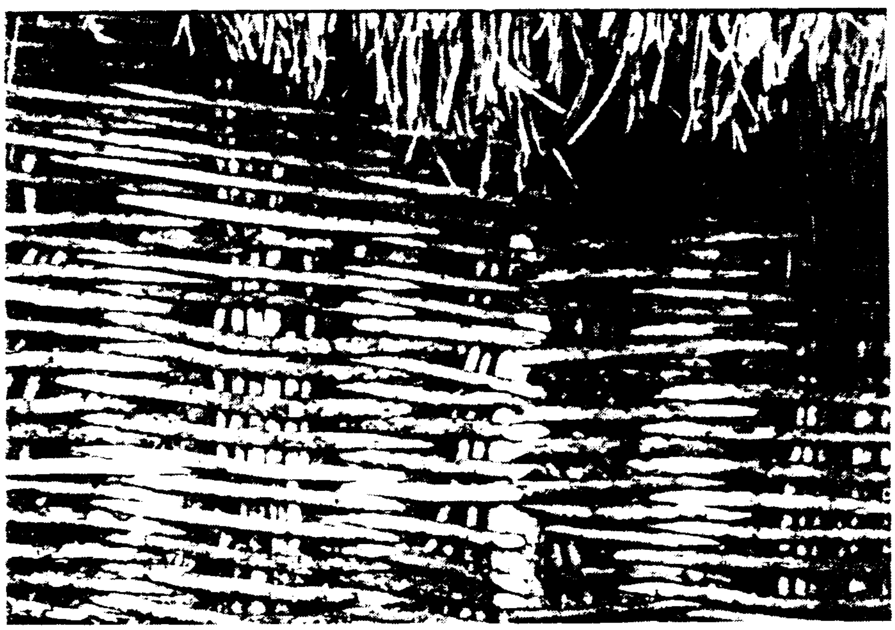


Fig 5 Lath woven wall showing main upright pole and thinner spacer laths.

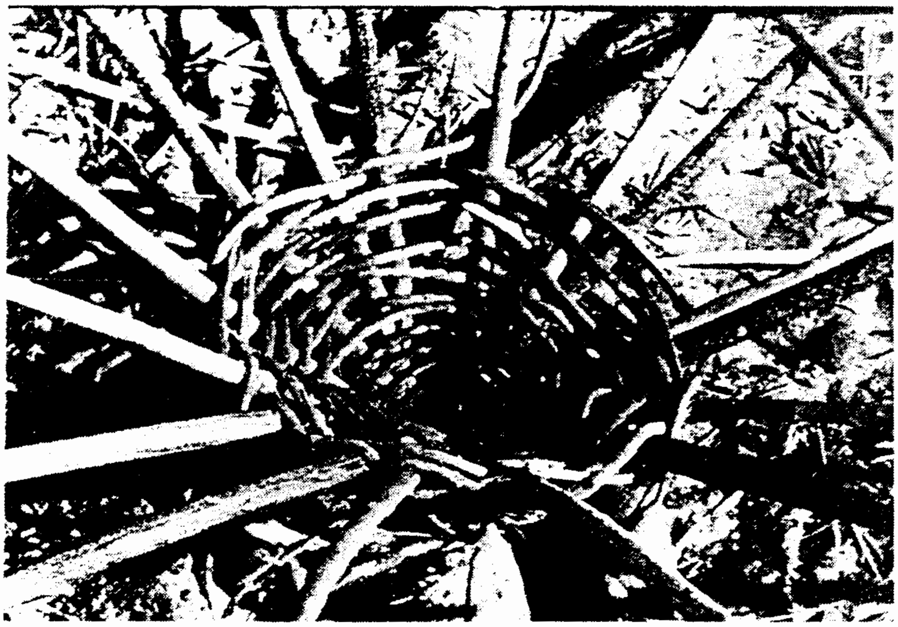


Fig 6 Apex of hut roof inverted for construction showing laths bound with flexible climber stems (*M.caffra* and *U.virens*).

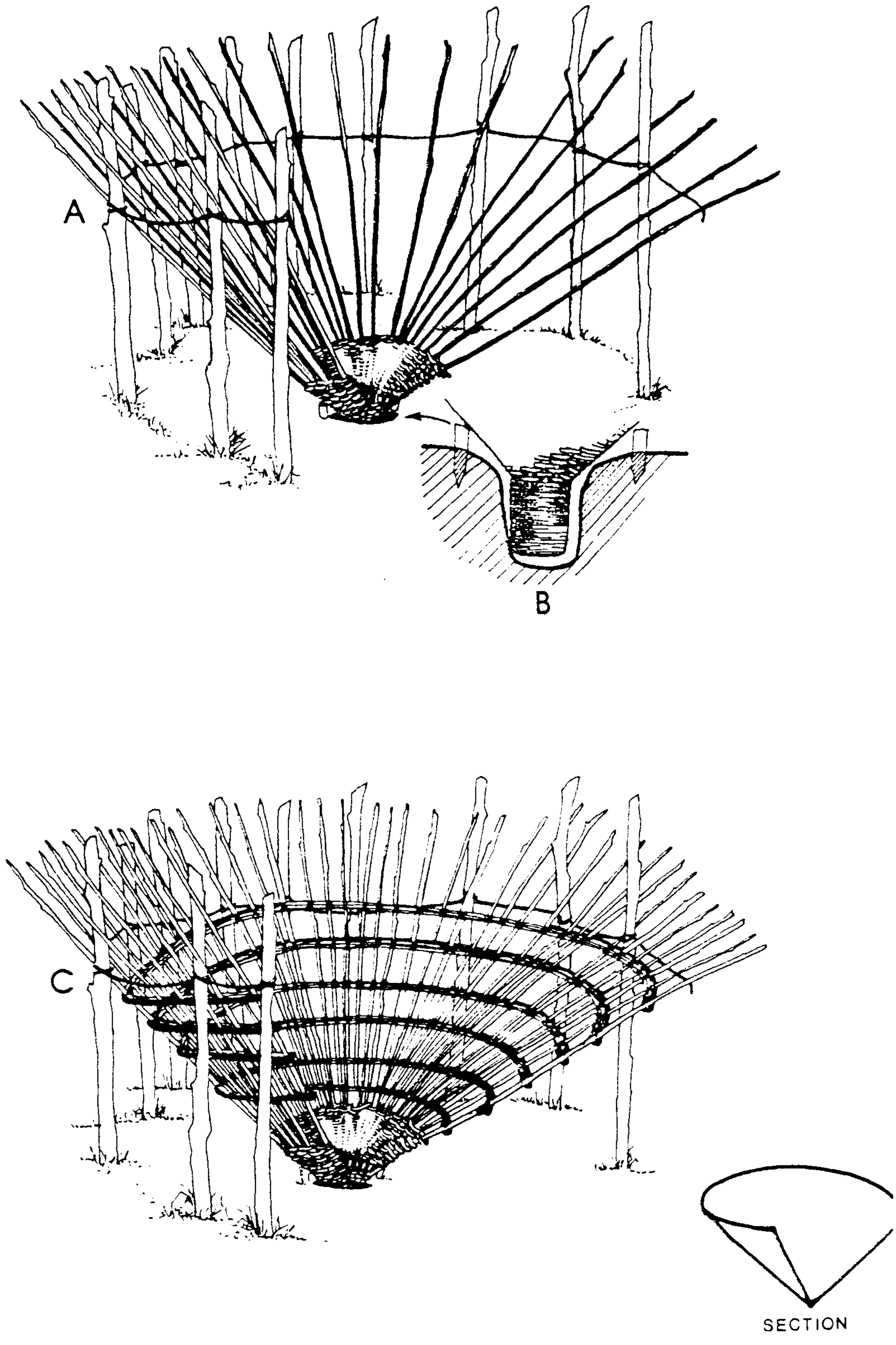


Fig 7 Stages in roof construction. A. Inverted roof structure with initial binding of laths. B. Apex of hut placed in a hole during construction showing pegs anchoring the roof into position. C. Inner and outer lath rings bound into position.

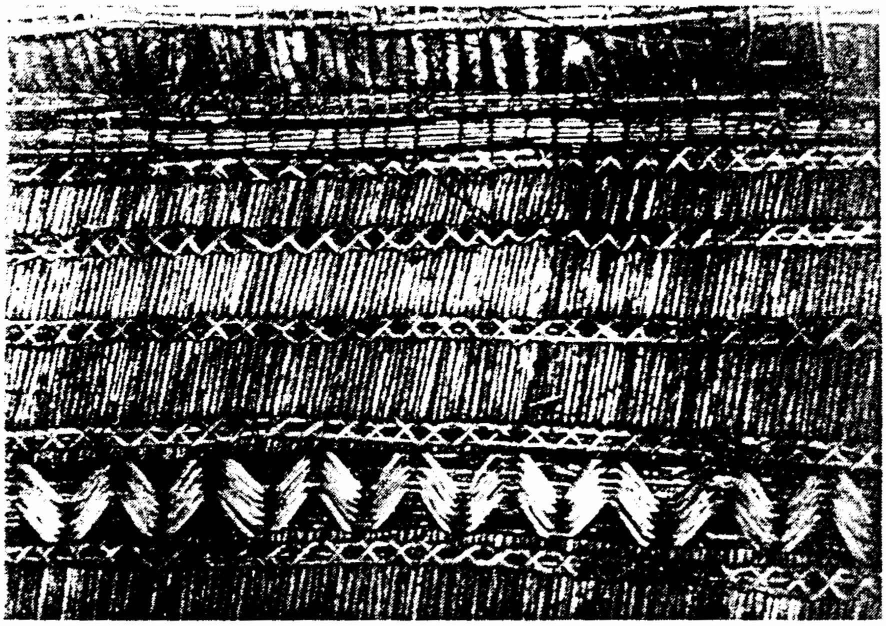


Fig 8 Wall of a traditional decorated hut showing reed (P.australis) bundles at the contact point with the roof and decorative weaving binding climber stems to a section of the wall.

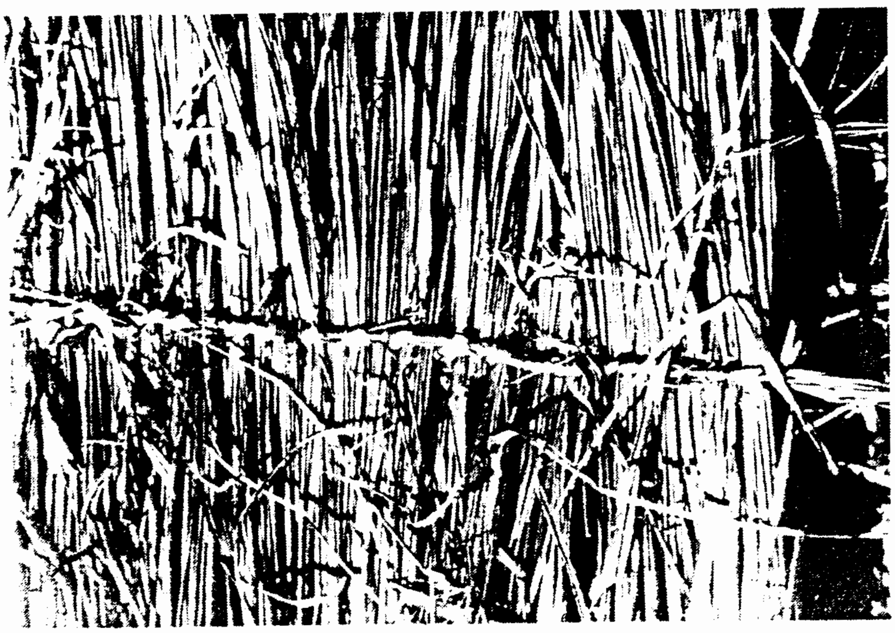


Fig 9 Section of thatching mat (I.cylindrica) bound onto a climber stem (A.precatorius) with strips of H.natalensis leaf.

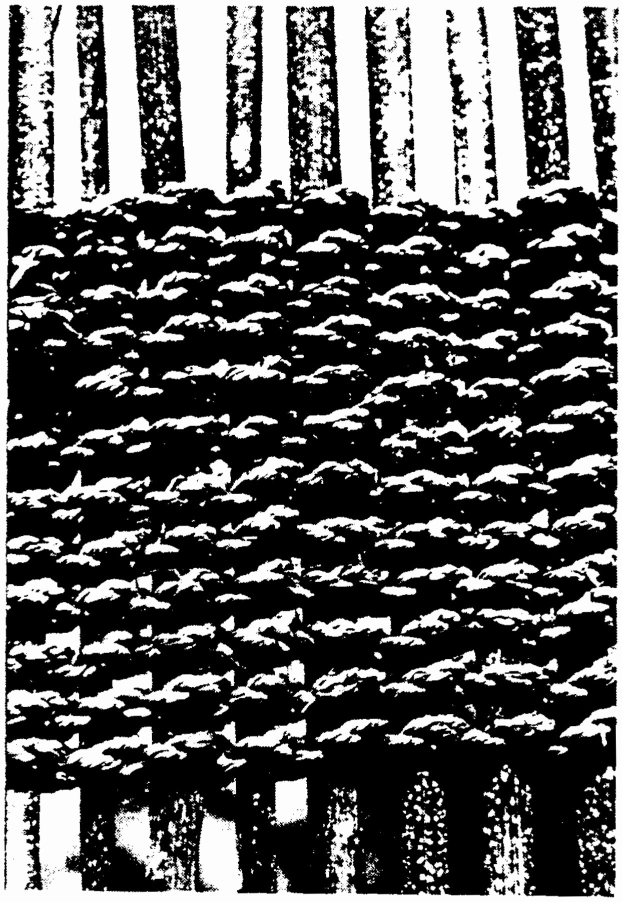


Fig 10 Partially completed door constructed of vertical laths (B.discolor) bound with H.natalensis twine.

Fig 11 Cut and longitudinally split C.papyrus culms being dried for use in making a traditional door.

place, the spacer poles are removed. When the wall has been completed, the reeds are trimmed off level with the plaited string (Figure 4).

Lath woven walls are constructed of thin (2 - 3 cm diameter) flexible laths 1 - 1,5 metres long that are woven between upright poles with thinnner spacer laths between them (Figure 5). Commonly used species are shown in Table 1. The builder then constructs the roof.

Roof construction

The ends of 5 - 7 laths are bent and bound together using flexible climber species (Hippocratea delagoensis, Uvaria caffra, U.lucida, Monanthotaxis caffra or Landolphia kirkii) to form the roof apex (Figure 6). This is stuck into a hole and supported by pegs (Figure 6 and 7). It may also be bound with plaited rope (Figure 7 b; Table I). The same climber species are also woven around the laths. Thicker laths are sharpened and pushed into spaces between the weaving resting on the climbers strung between poles around the circumference of the roof (Figure 7 a). Later these are supported by rings of laths bound 20 - 30 cm apart inside and outside the roof framework (Figure 7 c). The roof is then lifted into position onto the supporting poles. Downward movement of the roof is prevented by a bundle of laths bound adjacent to the uppermost circle of laths supporting the wall. Traditionally this bundle was also made of Vernonia neocorymbosa stems or short Phragmites australis reeds (Figure 8) but this is less frequent today.

The species of grass or sedge selected for thatching depends on the siting of the homestead and the amount of time available to the builder. Cyperus latifolius, Cladium mariscus and Mariscus species are available from coastal wetlands adjacent to permanent water-bodies. Cyperus fastigiatus and Eriochloa meyeriana are infrequent on the sandy coastal plain but are common on the Pongolo floodplain. Imperata cylindrica and Hyperthelia dissoluta are both found on disturbed soils but H.dissoluta is more common on the more weathered sands of the older dune ridges. Cymbopogon species (C.validus and C.excavatus) provide excellent thatch material but are seldom used because they grow in isolated clumps and are difficult to collect. However they were sometimes collected and sold to wealthier members of the community. This is reflected in the frequency of use of these species in different areas (Cunningham, in prep. a). I.cylindrica and H.dissoluta are commonly used in high population density areas where there is extensive disturbance. C.fastigiatus and E.meyeriana are used only for thatching on the Pongolo floodplain whilst C.latifolius, C.mariscus are rarely used away from coastal-plain wetlands. Similarly binding materials also differ between vegetation types. For example Ficus capreifolia twine and Bolusanthus speciosus poles used for hut-building in the Ndumu area (Pooley, 1980) do not occur on the sandy coastal plain. Conversely, H.tiliaceus, S.nicolai and F.trichopoda are used only near the coast.

Thatch is normally cut from May to the end of September. At this time these grass and sedge species are mature. The thatch grass is dried and then separated into smaller bundles. These are bound into mats about 6-8 metres long. Thin climber species are used as a basis for these mats (Landolphia kirkii, Abrus precatorius, Uvaria caffra, U.lucida, Monanthotaxis caffra). The thatch bundles are bound onto these climber stems using Hyphaene natalensis leaves, Strelitzia petiole or Ficus bark (Figure 9). Twenty to thirty mats are needed for a circular hut and 40 - 50 for a typical rectangular house. These bundles are stitched onto the roof framework finishing at the apex of the hut. This is made of woven grass and is commonly finished off with sharpened sticks to ward off birds (particularly owls) which are believed to bring misfortune (Figure 1 d and Appendix 1).

Door construction

Traditional doors were made of laths bound with Hyphaene twine (Figure 11), split and dried (Cyperus papyrus culms (Figure 12) or Phragmites reeds. Wood from Euphorbia ingens trunks was also used.

Fig 12 Decorative roof interior under construction showing a S.nicolai strip being pulled between the tightly coiled climbers (M.caffra and U.virens).

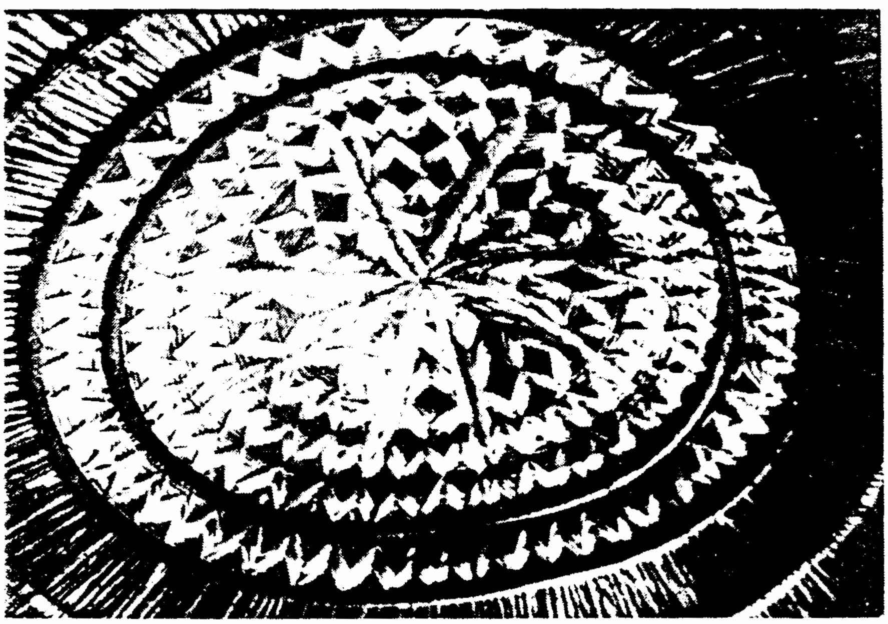


Fig 13 Completed interior of traditional decorated hut roof showing V-shaped stitches (S.nicolai) and inner lath bundles bound with F.trichopoda twine.

Decoration

Complex decoration is restricted to the homes of prominent members of the community that were built by specialist hut builders. In these huts, the climber species used in weaving the apex of the hut are wound around in concentric circles extending 1 - 1,5 m down from the hut apex while the hut is inverted and under construction (Figure 7). These are bound in place with _Strelitzia_ petiole strips using a V-shaped decorative stitch which is forced between the tightly bound climbers with a sharp tool (Figures 11 - 13). The inner lath rings of the roof may also be incorporated into the decoration by careful binding with _Ficus trichopoda_ bark twine (Figure 12). The same climber species and stitch may be used to decorate a section of the hut wall between inner lath rings (Figure 9) and for making circular decorative discs which are randomly fixed against the roof for good luck (Figure 14).

When the hut has been thatched, charms are placed in the hut to ward off bad luck. The roots of _Gardenia_ species (_Gardenia thunbergii_ and _G.spatulifolia_) are commonly used for this purpose. The hut floor is then finished by women who often walk long distances to collect soil with a higher clay content to cover the floor. Use of cow dung is not a popular method of hardening the floor as it is said to attract termites.

Fig 14 Disc characteristic of many of the decorated Tembe-Thonga huts.

Zulu and Tembe-Thonga terminology for the materials used and different sections of the hut is given in Appendix 1 and Table 1.

Table I. A list of indigenous plant species used for hut building on the Maputaland coastal plain. Species that potentially could be used but were not recorded in use for hut-building due to their restricted distribution (eg. Cavocoa aurea and Lasiodiscus miltbraedii) for laths or value for other purposes (eg. Juncus kraussii twine) are not included in the table.

FAMILY / Species	LOCAL NAME (Z=Zulu ; T=Tembe-Thonga) (Note: Some of these Zulu names may be derived from Tembe-Thonga)		USE (S=Stems ; B=Bark; R=Roots ; L=Leaves) Poles	Laths	Thatch	Reed walls	Binding material	Doors	Roof support bundle	COMMENTS
POACEAE										
Imperata cylindrica (L.) Beav.	umThente	(Z)								
	aLuhlwa	(T)			L,S					
Hemarthria altissima (Poir.) Stapf & C.E. Hubb	uMdlamvubu	(Z)			L,S					
Cymbopogon excavatus (Hochst.) Stapf ex Burtt Davy	isiCunga	(Z)								
	ashiQungu	(T)			L,S					
Cymbopogon validus Stapf ex Burtt Davy	isiCunga	(Z)								
	ashiQungu	(T)			L,S					
Hyperthelia dissoluta (Nees ex. Steud) W.D. Clayton	uHlongwa	(Z)								
	aHlongwa	(T)			L,S					
Eriochloa meyeriana (Nees) Pilg	iSwani	(Z)			L,S					
Digitaria eriantha Steud.	isiKhonkho	(Z)					L			twine
Rhyncheletrum repens (Willd.) C.E. Hubb	umKulane	(Z)			L,S					
Phragmites australis (Cav.) Trin ex Steud	umHlanga	(Z)			S	S			S	
Phragmites mauritianus Kunth	umHlanga	(Z)			S	S				
CYPERACEAE										
Cyperus fastigiatus Rottb	iNgqongozane	(Z)			S					
Cyperus latifolius Poir	iKhwane	(Z)								
	aKhwane	(T)			L		L			
Cyperus papyrus L	iDumu	(Z)								
	aDumu	(T)						S		
Mariscus sp.	iNsikane	(Z)								
	iKhekhe	(T)			L					
Euphorbia ingens E. Mey ex Boiss	umHlohlo	[illegible]								

FAMILY	LOCAL NAME		P	L	T	RW	BM	D	RSB	COMMENTS
ARACEAE										
Phoenix reclinata Jacq.	iSundu aNkindu	(Z) (T)				L				Leaf rachis occasionally used as an alternative to reeds in palmveld
Hyphaene natalensis Kuntze	iLala aNala	(Z) (T)					L			
Raphia australis Oberm & Strey	umVuma	(Z)	L							Leaf rachis used
AGAVACEAE										
Sansevieria guineensis (L.) Willd	isiKwendle ashiTokotoko	(Z) (T)					L			twine
MYRICACEAE										
Myrica serrata Lam.	uMakuthula isiHlwane	(Z) (Z)		S						
MORACEAE										
Ficus burtt-davyi Hutch	uLuzi	(Z)					B			*uzi* or *uluzi* are also general terms for twine rolled from fig bark. Other *Ficus* species (*F.capreifolia*, *F.natalensis*) make good rope but their use was not recorded on the coastal plain *F.lutea* and *F. verruculosa* are also suitable, but twine from these two species is not strong.
Ficus trichopoda	umFubu aluFubu	(Z) (Z)					B			
ANNONACEAE										
Uvaria caffra E.Mey. ex Sond	iNkonjane	(Z)					S			
Uvaria lucida Benth	iNkonjane; uMavumba	(Z)					S			
Monanthotaxis caffra (Sond.) Verdc.	iThunganhlanzi	(Z)					S			
	uMaluswembe	(Z)								
Sapium integerrimum (Hochst.) J.Leon.	umDlampunzi	(Z)		S						
[illegible]	[illegible]	[illegible]								

280

FAMILY	LOCAL NAME		P	L	T	RW	BM	D	RSB	COMMENTS
LEGUMINOSAE										
Albizia adianthifolia (Schumach.) W.F. Wight	iGowane	(Z)	S	S						
Albizia forbesii Benth	umNala; umFomoshane	(Z)	S							
Albizia versicolor Welw.ex Oliv.	umPhisu	(Z)	S	S						
Acacia Karoo Hayne	umuNga	(Z)					B			
Erythrophleum lasianthum Corb.	umKwangu	(Z)	S							
Afzelia quanzensis Welw.	umHlakuva; iNkhele	(Z)	S							
Newtonia hildebrandtii (Vatke) Torre	umFomothi	(Z)	S							
Dialium schlectei Harms	umThiba	(Z)	S							
Craibia zimmermannii (Harms) Harms ex Dunn	umPhungwane	(Z)	S	S						
Dalbergia obovata E.Mey	uDukuduku	(Z)								
	ashiLandula	(T)		S						
Abrus precatorius L.	umKhoka; isiSane	(Z)					S			
ERYTHROXYLACEAE										
Erythroxylum emarginatum Thonn.	uPhaphane	(Z)		S						
RUTACEAE										
Zanthoxylum capense (Thunb.) Harv.	isiNungwane	(Z)		S						
	umNungamabele	(Z)								
Toddaliopsis bremekampii Verdoorn	inTani	(Z)	S	S						
PTAEROXLACEAE										
Ptaeroxylon obliquum (Thunb.) Radlk.	umThathe	(Z)								
	mbhandadzwidzwi	(T)	S	S						
EUPHORBIACEAE										
Phyllanthus reticulatus Poir	umKhangu	(Z)								
	umTshwamtima	(T)		S						
Drypetes arguta (Muell. Arg.) Hutch	umKushwane	(Z)		S						
Drypetes natalensis (Harv.) Hutch	umKushwane	(Z)		S						
Hymenocardia ulmoides Oliv.	umDlamahlathi	(Z)								
	iTsatsalatsane	(T)	S	S						
Antidesma venosum E.Mey. ex Tul.	isiBangomlotha	(Z)		S						
	umShonga	(Z)								
Bridelia micrantha (Hochst.) Baill.	umHlahle	(Z)	S							
Croton gratissimus Burch	uHubeshane	(Z)	S	S						
Croton pseudopulchellus Pax	uHubeshane	(Z)		S						
Croton steenkampianus Gerstner	uHubeshane	(Z)		S						
Suregada zanzibariensis Baill.	umKushwane-elikhulu	(Z)		S						
Spirosyachys africana Sond.	umThombothi	(Z)	S							
Sapium intergerrimum (Hochst.) J.Leon.	umDlampunzi	(Z)		S						
Euphorbia ingens E.Mey ex Boiss	umHlohlo	(Z)								

FAMILY	LOCAL NAME		P	L	T	RW	BM	D	RSB	COMMENTS
ANACARDIACEAE										
Ozoroa obovata (Oliv.) R.& A. Fernandes	isiFici	(Z)	S							
Rhus guenzii Sond.	umPhondwe; umPhondo	(Z)		S						
CELASTRACEAE										
Hippocratea delagoensis Loes.	isiFindwane	(Z)					S			
Salacia leptodlada Tul.	iHlangahomo	(Z)		S						
ICACINACEAE										
Apodytes dimidiata E.Mey ex Arn.	umDakane	(Z)	S							
SAPINDACEAE										
Haplocoelom gallense (Engl.) Radlk.	umThambo	(Z)	S							
RHAMNACEAE										
Ziziphus mucronata Willd	umPhafa; umLahlankosi	(Z)	S							
TILIACEAE										
Grewia caffra Meisn	iSaka; uPhata	(Z)		S						
Grewia microthyrsa K.Schum ex Burret	umMunywane	(Z)		S						
MALVACEAE										
Hibiscus tiliaceus L.	umLolwe	(Z)					B			
STERCULIACEAE										
Cola natalensis Oliv.	umQosho	(Z)		S						
OCHNACEAE										
Ochna arborea Burch ex DC.	isiBomvane	(Z)								
	anShelelo	(T)		S						
COMBRETACEAE										
Combretum molle R.Br. ex G.Don	umBondwe	(Z)	S							
Pteleopsis myrtifolia (Laws) Engl. & Diels.	uMwandla	(Z)	S	S						
Terminalia sericea Burch. ex DC.	uKonono	(Z)	S				B			
MYRTACEAE										
Syzygium cordatum Hochst.	umDoni	(Z)								
	anDoni	(T)	S							

FAMILY	LOCAL NAME		P	L	T	RW	BM	D	RSB	COMMENTS
MYRSINACEAE										
<u>Rapanea melanophloeos</u> (L.) Mez	isiCalabi	(Z)	S	S						
SAPOTACEAE										
<u>Mimusops caffra</u> E.Mey. ex A.DC	amaSethole; umTholo	(Z)								
<u>Mimusops obovata</u> Sond	amaSethole-ehlathi	(Z)								
<u>Manilkara concolor</u> (Harv. ex C.H.Wr.) Gerstner	umNqambo	(Z)	S	S						
<u>Manilkara discolor</u> (Sond.) J.H.Hemsl.	umNwebe	(Z)								
	aNywebe	(T)	S	S						
EBENACEAE										
<u>Diospyros inhacaensis</u> F. White	iNhlayane-emnyama;	(Z)								
	isiThomane	(Z)	S	S						
<u>Diospyros natalensis</u> (Harv.) Brenan	iNhlayane-emhlope	(Z)	S	S						
LOGANIACEAE										
<u>Strychnos decussata</u> (Pappe) Gilg	umPatankosi	(Z)	S	S						
<u>Strychnos henningsii</u> Gilg	umKangala; umQalothi	(Z)	S	S						
<u>Strychnos madagascariensis</u> Poir	umKwakwa	(Z)	S	S						
<u>Strychnos mitis</u> S. Moore	uManono	(Z)		S						
APOCYNACEAE										
<u>Landolphia kirkii</u> Dyer	umBungwa	(Z)								
	amBungwa	(T)					S			
<u>Voacanga thouarsii</u> Roem. & Schult.	umKahlwana	(Z)								
	anKahlu	(T)	S							
<u>Wrightia natalensis</u> Stapf	umPhengende	(Z)		S				S		Planks made for doors
RUBIACEAE										
<u>Catunaregam spinosa</u> (Thunb.) Tirvengadum	isiKhwakhwane	(Z)	S	S						
<u>Coddia rudis</u> (E.Mey ex Harv.) Verde	umDondwane	(Z)								
	ashiMane	(T)		S						
<u>Gardenia amoena</u> Sims	umTembeswane	(Z)		S						
<u>Tricalysia sonderana</u> Hiern.	uTolomba-ehlathi	(Z)		S						
<u>Kraussia floribunda</u> Harv.	isiKhubashane	(Z)		S						
<u>Canthium obovatum</u> Klotzch	umHlelehlele	(Z)		S						
COMPOSITAE										
<u>Vernonia neocorymbosa</u> Hilliard	isiLelevu-elukhulu	(Z)							S	
<u>Brachylaena discolor</u> DC	iPhahla	(Z)		S						

DISCUSSION AND CONCLUSION

Culture and the environment are both dynamic and many changes are inevitable. Building methods and sources of building material are both being altered by the effects of man. Despite the many advantages of thatch, corrugated iron is replacing thatch as a roofing material, particularly at economic growth points (Cunningham, in prep a). Paradoxically, it is in these places where the supply of thatch species growing on disturbed soils (particularly I.cylindrica and H.dissoluta) is increasing. Conversely, clearing of forest areas for agriculture has reduced the supply of straight hardwood poles available from Coastal forest.

Recording the building methods and plant species used in Tembe-Thonga hut construction is important if only as an historical marker. It can also provide some insight into the interpretation of historical sites on the sandy coastal plain. Most utensils, building materials and craftwork are biodegradable. The only exceptions are the clay pots made in the Lebombo Mountains and traded to people on the coastal plain, pots and palm wine collection containers made from scattered patches of poor quality local clay and the rocks imported into the area for cracking Sclerocarya birrea kernels. Even recent sites 10 - 20 years old area are often only recognizable by the prescence of trees that were conserved for their shade or fruits and those that have germinated from seeds thrown out after collection of the fruits for home consumption.

Trichilia emetica, Strychnos spinosa, Vangueria infausta, Strychnos madagascariensis, Manilkara discolor, Sclerocarya caffra and the exotic Mangifera indica are all common fruit sources found at homestead sites on the coastal plain.

The Tembe tribal ward is not only a species rich area with a high conservation rating (Bruton, 1980). Its people also have a rich cultural history (Junod, 1927 ; Hedges, 1978). The knowledge that the Tembe people have of plant uses is a reflection of the historical association between man and the environment. Traditional hut building techniques and particularly the decorated Tembe-Thonga hut are an aesthetically beautiful and functional example of this interaction. Yet like the implements and weapons made by the iron-smith, the specialist hut builders craft is becoming obsolete - a victim of consumerism, concrete block and corrugated iron. However, for the majority of local people, indigenous plant resources still represent a low cost building resource.

Although styles may change, the demand for indigenous materials (particularly reeds, hardwood poles and laths) and the need for woodlots is increasing (Cunningham, in prep. a and b).

ACKNOWLEDGEMENTS

This paper would not have been possible without the help and interest of R. Mkhonto, M. Mlungwana, P. McLaren, M. Gwala and D.R. MacDevette. Funding to A.B.C. from the CSIR whilst writing up the research work done in Maputaland is very much appreciated. We are also grateful to D.R. MacDevette for the loan of his slides for Figures 8 and 13.

REFERENCES

Bruton, M.N. 1980. Conservation and development in Maputaland pp. 497-529 in "Studies on the ecology of Maputaland". M.N. Bruton and K.H. Cooper ed Cape and Transvaal Printers, Cape Town.

Coates-Palgrave, K.H. 1977. Trees of Southern Africa. C. Struik, Cape Town.

Cunningham, A.B. in prep a. Hut-building resource use by rural people in Maputaland, South Africa.

Cunningham, A.B. in prep b. Commercial harvesting of Phragmites australis reeds in a low agricultural potential area.

Cunningham, A.B. in prep c. A list of plant species used by the Tembe-Thonga people in Maputaland, South Africa.

Felgate, W.S. 1965. An ecological study of the Tembe-Thonga people. Unpublished report on research work, edited by E.J. Krige 67 pp.

Felgate, W.S. 1982. The Tembe-Thonga of Natal and Mocambique: an ecological approach. Department of African Studies, University of Natal, Occasional papers No. 1.

Hedges, D.W. 1978. Trade politics in southern Mozambique and Zululand in the eighteenth and early nineteenth centuries. Unpublished PhD thesis, University of London.

Junod, H.A. 1927. The Life of a South African Tribe. Reprint by University Books, Inc., New York 1962.

Knuffel, W.E. 1973. The Construction of the Bantu Grass Hut. Gras. Akademische Druk. 85 pp.

Liengme, C.A. 1983 a. A study of wood use for fuel and building in an area of Gazankulu. Bothalia 14 (2) : 245-257.

Liengme, C.A. 1983 b. Plants used by the Tsonga people of Gazankulu. Bothalia 13 (3/4) : 501-518.

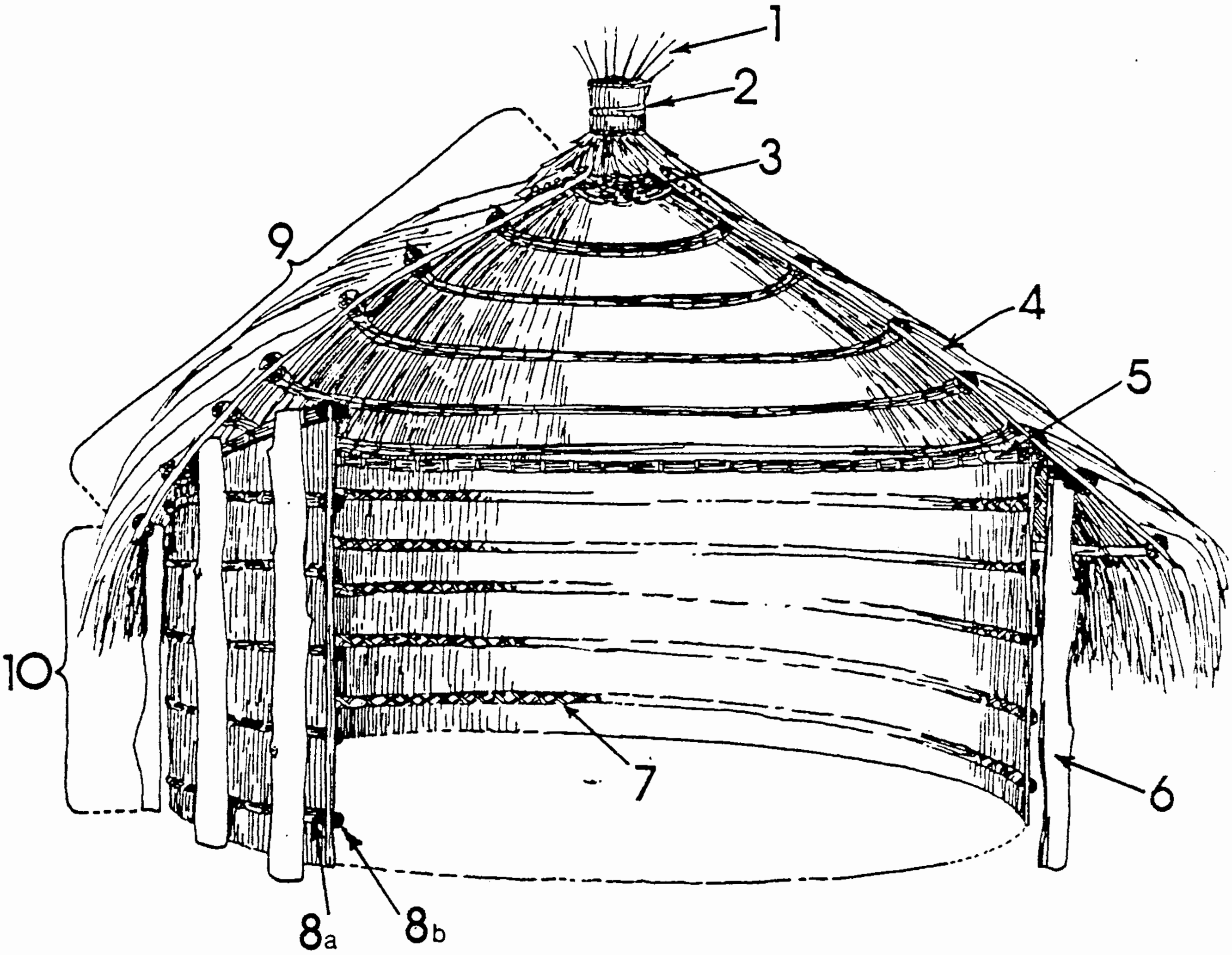
Loxton, Hunting and Associates. 1969. The Natural Resources of Maputaland. Unpublished map series.

Maud,R.R. 1968. Quaternary geomorphology and soil formation in Coastal Natal. Zeits. Geomorph. Suppl. 7 : 155-199.

Maud, R.R. 1980. The climate and geology of Maputaland. 1-7 in "Studies on the ecology of Maputaland. M.N. Bruton and K.H. Cooper (ed) Cape and Transvaal Printers, Cape Town.

Palmer, E. and N. Pitman. 1972. Trees of Southern Africa. 3 Vols. A.A. Balkema, Cape Town.

Pooley, E.S. 1980. Some notes on the utilization of natural resources by the tribal people of Maputaland pp. 467-479 In "Studies on the ecology of Maputaland". M.N. Bruton and K.H. Cooper (ed) Cape and Transvaal Printers, Cape Town.



APPENDIX 1

ZULU (Z) AND TEMBE-THONGA (T) TERMINOLOGY FOR SECTIONS OF THE HOME (UMUZI).

1. iziNti (Z) = sharpened sticks at roof apex to keep away unlucky birds (particularly owls)

2. ashiHlungu (T) = apex of hut, often containing Gardenia spatulifolia root (protective charm)

3. isiNyonywane (Z), abuHlangwe (T) = binding with creepers near hut apex

4. uTshani (Z), aJhwanyi (T) = thatch made in a series of bundles forming a mat (iQeku)

5. isiPhetho (Z) = roof support bundle

6. iNtsika (Z), atiMpande (T) = roof support pole

7. uKhubo (Z) = decorative criss-cross weaving

8a amaBhalelo-angaphandle (T) = inner (a) and outer (b) wall support laths

b amaBhalelo-angaphakathi (T) (Note : flexible thin laths are amaBhalelo (T) or amaTando (Z). Thicker laths are referred to as atiNhungu (T) or iziNtingu (Z)

9. iLwangu (Z) = roof

10. iKhumbi (Z) = wall

The interior of the hut is divided into two sections. The men sleep in one section (ashiLawu) and the women in the other.

SECTIONS G & H

NUTRITIONAL VALUES : PALM WINE, FRUITS AND SPINACH

"Besides the Liquor or Water in the fruit, there is also a sort of wine drawn from the tree called Toddy, which looks like Whey. It is sweet and very pleasant, but it is to be drunk within twenty-four hours after it is drawn, for afterwards it grows sowre".

Dampier, 1686 (Voyages, London. 1806) in Gibbs (1911)

Nama e a êtêla, morôgô ke wa ka mehla
(meat is a visitor whereas pot-herbs* are daily food)

Pedi proverb Quin (1959)

* ie. spinach (imifino)

THE NUTRITIONAL VALUE OF *Hyphaene natalensis* AND *Phoenix reclinata* PALM WINE

A B CUNNINGHAM[1] AND A S WEHMEYER[2]

ABSTRACT

The objective of this study was to do more detailed analyses of palm wine than were previously available in order to evaluate the nutritional value of this indigenous plant resource to rural people in this low agricultural potential area. The results showed that palm wine, which was commonly consumed by rural people in the study area, had a low alcohol content (3.6% v/v) and was an important source of nicotinic acid (0.22 - 0.5 mg/100 g) and vitamin C (6.3 - 6.8 mg/100 g). However the value of palm wine as a source of protein, thiamin and riboflavin appear to have been overestimated by previous studies.

INTRODUCTION

Palm sap tapped from *Hyphaene natalensis* O. Kuntze and *Phoenix reclinata* Jacq. and fermenting due to naturally occurring yeasts (Nash and Bornman 1973) produces an alcoholic beverage known as palm wine (Cunningham, in prep b). This was the

1 Department of Botany, University of Cape Town, Rondebosch 7700

2 National Food Research Institute, CSIR, P O Box 395, Pretoria 0001

most popular alcoholic beverage sold in the Ingwavuma district, Natal, South Africa. During a twelve month period in 1981 - 1982 nearly 1 000 000 litres of palm wine were sold, making a significant contribution to the regional rural economy through the sale, transport and re-sale of the beverage (Cunningham, in prep a). The nutritional value of this palm wine is well known, mainly from data presented by Campbell (1969) and Felgate (1965, 1982). Despite the availability of other data on palm wine nutrient content (Heard, 1955; van der Merwe et al, 1967; Nash and Bornman, 1973) only Campbell (1969) and Felgate (1965) have been used as a reference source for research and planning reports on the area (Poultney, 1980; Bruton, 1980; Tinley and van Riet, 1981).

This study was done for two reasons. Firstly, the protein and riboflavin values of palm wine analysed by Leong (1953) (for *Cocos nucifera* **L.** palm wine) and Heard (1955) were lower than Campbell (1969) and Felgate (1965, 1982) maintained. Secondly there was a need for more detailed analyses than those that had previously been done on *H.natalensis* palm wine. No data were available on the nutritional value of *P.reclinata* palm wine although it was commonly tapped in the study area (Cunningham in prep b).

METHODS

The close co-operation of a palm wine tapper during a study on palm wine yields (Cunningham, in prep b) gave the opportunity for palm wine to be collected from each of the palm species at the onset of fermentation. Two 5 litre samples of *H.natalensis* sap and one 5 litre sample of *P.reclinata* sap were collected for analysis and were flown to the CSIR for analysis within 36 hours. Nutritional values were compared against minimum RDA figures given by the National Research Council (1980) rather than those of Passmore et al (1974).

RESULTS

The results of the analyses are summarised in Table 1 presenting the two samples of *H.natalensis* palm wine separately.

Table 1 The nutrient composition of palm wine from two palm species.

SOURCE OF PALM WINE		g/100 g					kJ/ 100 g	mg/100 g													% v/v	REFERENCES
	Moisture	Ash	Protein	Fat	Fibre	CHO	Energy Value°	Ca	Mg	Fe	Na	K	Cu	Zn	Mn	P	Thiamin	Riboflavin	Nicotinic Acid	Vit C	Alcohol	
HYPHAENE NATALENSIS [a]	98.2	0.4	0.2	-	-	1.2	24+112	0.9	5.4	1.4	13.3	155	0.07	0.03	0.05	7.8	0.02	0.01	0.28	6.3	3.7	this study
PHOENIX RECLINATA [b]	98.3	0.4	0.2	-	-	1.1	22+109	0.45	5.12	0.07	5.85	157	0.05	0.02	trace	1.74	0.01	0.01	0.5	6.5	3.6	this study
HYPHAENE NATALENSIS [b]	98.8	0.4	0.1	-	-	0.7	13+109	0.13	4.18	0.07	9.88	152	0.04	0.01	trace	1.37	0.01	0.01	0.22	6.8	3.6	this study
HYPHAENE NATALENSIS			0.4															0.02	0.4			Heard, 1955
HYPHAENE NATALENSIS																		0.44**				Felgate, 1965, 1982
HYPHAENE NATALENSIS			0.82*																			Campbell, 1969
HYPHAENE NATALENSIS										140							28		257		2.0	Nash and Bornman, 1973

° The second value in this column is energy supplied by the alcohol.

* Campbell (1969) found 14 g protein per 3 pints (1.7 litres) of palm wine

** Felgate (1965, 1982) stated that there were 7.5 mg riboflavin in 3 pints (1.7 litres) of palm wine

a. Sample was freeze dried and all analyses except Vitamin C were done on freeze dried material.

b. All analyses were done on the liquid samples as received.

DISCUSSION

Two main points arise from the analyses done for this study. Firstly the vitamin C content of palm wine. Secondly the differences between data given by Felgate (1965, 1982), Campbell (1969) and Nash and Bornman (1973) and data in Heard (1955) and this study which cannot be accounted for as variation between different samples or methods of analysis (see Table 1).

Palm wine is a valuable source of nicotinic acid (Heard, 1955; Felgate, 1965, 1982), vitamin C and potassium (this study). However, there is doubt about the availability of all the thiamin from palm wine due to the presence of live yeast cells (Nash and Bornman, 1973) but it is not an important thiamin source. It is also a poor source of calcium (Leong, 1953, this study), but a fair source of magnesium - one litre supplying 14% of the RDA for magnesium. One litre of palm wine would provide 2.5 - 5.0 mg nicotinic acid (19 - 38% RDA) and 63 - 68 mg vitamin C requirement (105 - 113% RDA) of an adult male 23 - 50 years old. These nutrients are important in supplementing the starchy diet of rural people which is not only low in nicotinic acid and vitamin C but also in riboflavin, calcium and protein (Groenewald et al 1981, Beyers et al 1984). Nicotinic acid deficiency is one of the factors causing pellagra, a deficiency disease more common amongst Zulu adults than children in KwaZulu (Hennessy and Lewis, 1971). Nash and Bornman (1973) considered that palm wine was a useful supplement rather than a dietary essential in the area because of the availability of fish, crops and indigenous fruits in the area. We consider it likely that it is a very useful source of nicotinic acid and vitamin C to men in the area. Firstly, although vitamin C and nicotinic acid are found in fruits (van der Merwe et al. 1967; Cunningham, in prep c) and spinach species (Lewis et al. 1968; Hennessy and Lewis, 1971; Gomez, 1982) eaten in the area, these are consumed more frequently by women and children than by men. Secondly, due to the social importance, low price and common use of palm wine as payment for assistance with hut building or ploughing, palm wine is regularly consumed in large quantities (1-2 litres per day and sometimes in excess of 5 litres at celebrations). An added advantage is that palm wine is available (and consumed) throughout the year, (apart from February - March when beer brewed from Sclerocarya birrea fruit is obtainable (Cunningham in prep b)), while most fruits and spinaches are seasonally available.

What has been overemphasised is the importance of palm wine as a source of riboflavin (by Felgate, 1965, 1982) and protein (by Campbell, 1969). It is also important to note that Nash and Bornman (1973) obtained unusually high values for the iron, thiamin and nicotinic acid content of palm wine and that these do not appear to be representative of palm wine consumed in the area (Heard, 1955; this study). Neither Felgate (1965, 1982) nor Campbell (1969) give their methods of collection or analysis and neither does Felgate (1965, 1982) give a source of reference for his calculation of minimum dietary requirements. Yet both Felgate (1962, 1982) and Campbell (1969) have been extensively quoted in this regard in research and planning reports dealing with the area (Felgate, 1965, 1982 (quoting Campbell, 1969); Poultney, 1979; Bruton, 1980; Tinley and van Riet, 1981) despite the availability of other nutrient data (Heard, 1955; van der Merwe et al. 1967 and Nash and Bornman, 1973). Felgate (1965, 1982) stated that three pints of palm wine (1.7 litres) contained 7.5 mg of riboflavin or 22% of the daily riboflavin requirement. These data are contradictory as 7.5 mg represents 469% of the daily riboflavin requirement (1.6 mg) for a 23-50 year old male according to the RDA tables (Anon, 1979). According to Campbell (1969), three pints of palm wine contained 14 g of protein, which was 4 g more than the requirements set down by the British Colonial dietary. Both the riboflavin and protein values of these authors are far higher than those of Leong (1953)(for Cocos nucifera palm wine), Heard (1955) or this study. Fourteen grams of protein would also not exceed the current RDA requirement (56 g per person (a 23-50 year old male) per day). Palm wine could nevertheless be an important supplementary source of the amino-acid lysine. Nash and Bornman (1973) obtained 600 μmol lysine/100 mℓ filtered palm wine (876 mg lysine/l). This would make a significant supplement to a cereal staple diet low in this amino-acid if as high as this in palm wine consumed in the study area. However, the values that Nash and Bornman (1973) obtained for the iron, thiamine and nicotinic acid content of palm wine were all considerably higher than the levels shown by the analysis for this study and of nicotinic acid in Heard (1955). Although the high iron content could perhaps have resulted from the palm wine tapper using metal tins to collect the palm sap, it seems unlikely that 100 mℓ of palm wine would contain 28 mg thiamine (2333% RDA) and 257 mg nicotinic acid (1976% RDA). For this reason only the analyses for this study were used in the food tables in Cunningham in prep c.

About half of the palm wine sold in the study area (nearly 500 000 litres) was sold for consumption rather than for re-sale. This was usually consumed in undilute form within 36 hours of the sap being collected, which would correspond to the age of the palm wine analysed in this study and by Heard (1955). The rest was sold by an estimated 54-65 homesteads in the Ingwavuma district (Cunningham, in prep a). This is normally diluted with water (to double the volume and therefore provide a profit margin on re-sale) and sugar is added. Alcohol formation in palm wine starts to decline after 20-30 hours (Gibbs, 1911) and the addition of sugar would be necessary to increase the alcohol content of the dilute palm wine. Consumption (after re-sale) would then take place within the following 24 hours, about 50-60 hours after the palm sap was collected. The influence of this treatment and ageing on the nutritional value and alcohol content of palm wine needs to be investigated for two reasons. Firstly the nutritional value of the palm wine may increase after ageing, when yeast cells disintegrate and release their contents (Nash and Bornman, 1973). Secondly the dilution and addition of sugar could increase the alcohol content and decrease the nutritional value of palm wine.

Despite these discrepancies, there is little doubt of the nutritional and social value of undiluted palm wine in addition to its economic value (Cunningham, in prep a, b). This is a common factor with other traditional alcoholic beverages which have a low alcohol content (see Table 1 for palm wine) and a high nutritional value and social importance (Goldberg and Thorpe, 1946; Platt, 1955; Gouws and Langenhoven, 1982). What is necessary is to recognise this and to follow the advice given by Bryant (1908) that "Governments in their legislation thereanent should recognise this fact, and aim rather at preventing its abuse rather than preventing its use".

ACKNOWLEDGEMENTS

We wish to thank Mrs G. Armbruster, Mr R. Bagnari, Mrs A. Fourie, Miss T. Saunders, Mrs S. Smit and Miss E. Strydom of the Division of Food Chemistry, National Food Research Institute of the CSIR for technical assistance. One of us (A.B.C) acknowledges partial funding received from the Human Needs, Resources and the Environment Section of the Council for Scientific and Industrial Research (CSIR).

LITERATURE CITED

Anon. 1979. Revised Recommended Dietary Allowances. J. Am. Dietet. A. 75 : 623 - 625.

Beyers, M.J.C., M.L. Langenhoven, J.P. du Plessis, J.J. Ferreira, A.S.P. Swanepoel, P.C.J. Jordaan. 1984. Nutritional value of diets of Blacks in Ciskei. S. Afr. Med. J. 65 : 338 - 345.

Bruton, M.N. 1980. Conservation and Development in Maputaland. pp. 497 - 519 in studies on the ecology of Maputaland. M.N. Bruton and K.H. Cooper ed, Cape and Transvaal Printers, Cape Town.

Bryant, A.T. 1908. A description of native foodstuffs and their preparation. The Times, Pietermaritzburg, Natal, South Africa.

Campbell, G.G. 1969. A review of scientific investigations in the Tongaland area of northern Natal. Trans. R. Soc. S. Afr. 38 : 305 - 316.

Cunningham, A.B. in prep a. Palm wine tapping in Maputaland, South Africa. I. Contribution to the regional rural economy.

Cunningham, in prep b. Palm wine tapping in Maputaland, South Africa. II. Yields, individual profits and carrying capacity.

Cunningham, A.B. in prep c. The nutrient composition and dietary importance of veld foods eaten in Maputaland, South Africa.

Felgate, W.S. 1965. An ecological study of the Tembe-Thonga people. Unpublished report on research work. E.J. Krige ed, 167 pp.

Felgate, W.S. 1982. The Tembe-Thonga of Natal and Mozambique: an ecological approach. Department of African Studies, University of Natal, Occasional Publications No. 1. 182 pp. E.J. Krige, ed.

Gibbs, H.D. 1911. The Alcohol Industry of the Phillipine Islands. Phillip J Sci. 6 : 147 - 206.

Goldberg, L. and Thorp, J.M. 1946. A survey of vitamins in African Foodstuffs. VI. Thiamin, Riboflavin and Nicotinic Acid in sprouted and fermented cereal foods. S. Afr. Med. Sci. 11 : 177 - 185.

Gomez, M.I. 1982. Sources of Vitamin C in the Kenya diet and their stability to cooking and processing. Ecol. Food. Nutr. 12 : 179 - 184.

Gouws, E. and M.L. Langenhoven. 1982. National Research Institute for Nutritional Diseases Food Composition tables. S.A. Medical Research Council. Parow, South Africa. 100 pp.

Groenewald, G, M.L. Langenhoven, M.J.C. Beyers, J.P. Du Plessis, J.J. Ferreira, S.J. van Rensburg. 1981. Nutrient intakes among rural Transkeians at risk for oesophageal cancer. S. Afr. Med. J. 60 : 964 - 967.

Heard, C.R.C. 1955. Palm wine in human nutrition. Proc. Nutr. Soc. 14 : xi - xii.

Hennessy, E.F. and O.A.M. Lewis. 1971. Anti-Pellagragenic properties of wild plants used as dietary supplements in Natal (South Africa). Pl. Fds. Hum. Nutr. 2 : 75 - 78.

Leong, P.C. 1953. The nutritive value of coconut toddy. Brit. J. Nutrition 7 : 253 - 259.

Lewis, O.A.M., B.M.G. Shanley and E.F. Hennessy. 1968. The leaf protein nutritional value of four wild plants used as dietary supplements by the Zulu. pp. 95 - 102 in Proteins and Food Supply in the Republic of South Africa. J.W. Claasens and H.G. Potgieter ed, A.A. Balkema, Cape Town.

Nash, L.J. and C.H. Bornman . 1973. Constituents of ilala wine. S. Afr. J. Sci. 69 : 89 - 90.

Passmore, R., M.R Narayana, B.M. Nicol, G.H. Beaton and E.M. De Mayer. 1974. Handbook on nutritional requirements. FAO Nutritional Studies No. 28. FAO, Rome.

Poultney, C. 1980. Subsistence and utiliaztion of resources by the inhabitants of the Mthikeni/Nsimbi pans region of the Pongolo floodplain. HSRC/CSIR unpublished report.

Tinley, K.L. and W.F. van Riet. 1981. Tongaland, zonal ecology and rural land-use proposals. Unpublished report, Department of Co-operation and Development, Pretoria, South Africa.

van der Merwe, A. le R, I.M. Burger, and A.S. Wehmeyer. 1967. Suid-Afrikaanse Veldkosse : 1. Makatini-Vlakte, Noord Natal. National Food Research Institute, CSIR, Pretoria, South Africa.

USE AND DIETARY IMPORTANCE OF EDIBLE INDIGENOUS PLANTS IN MAPUTALAND, SOUTH AFRICA

A. B. CUNNINGHAM

ABSTRACT

The aims of this study were firstly to systematically record all indigenous plant species used as dietary supplements by Tembe-Thonga and Zulu subsistence agriculturalists in Maputaland, South Africa, secondly to determine the selective use of the species available and thirdly to obtain data on the nutrient composition of these commonly collected species. Over 100 indigenous plant species provide a source of edible fruits, spinaches, beer and insects. A relatively small range of species were regularly collected. Most of these were eaten in season with few fruits, spinaches or insects being stored. There was a seasonal limit to the value of fruits, insects and *Sclerocarya birrea* fruit beer as a source of dietary nutrients. Fungi (mushrooms) were seasonally available but had little dietary importance. However, palm wine, *Sclerocarya birrea* kernels and most spinaches (*imifino*) were an important year round source of nutrients supplementing the starchy staple diet. Eighteen indigenous fruits, eight indigenous spinaches and two beers made from indigenous plants were evaluated in terms of their potential value as sources of nutrients commonly deficient in the diet of rural people. The implications of this for conservation and primary health care policy are discussed.

Botany Department
University of Cape Town
RONDEBOSCH 7700

INTRODUCTION

In a recent literature review on the use of edible indigenous plants in sub-Saharan Africa Grivetti (1980, 1981) emphasised the relevance of studies on indigenous plant foods to agricultural development and recommended that:

1) under-utilized or under-exploited indigenous plants should be considered a research priority within agricultural development programmes

2) a systematic effort should be made to provide a nutritional data base on the energy, vitamin and mineral composition of important edible indigenous plants

3) indigenous plant species should be examined for their potential for further development.

The main focus of ethnobotanical research in Southern Africa in the past has been to record the uses of plants and their vernacular names (Liengme, 1983). Records of commonly used edible plants in Maputaland, South Africa have followed this trend (Felgate, 1965, 1982, Lubbe et al, 1973, Pooley, 1978, 1980 and Poultney, 1980). Such studies are valuable as they document part of the customary knowledge of African people which is rapidly disappearing with cultural and technological change. However these data are of limited use for any assessment of the value of indigenous plants as a food source. Ideally the evaluation of the actual dietary value of indigenous plants requires data on dietary intake, nutrient composition and biological assimilation of nutrients from these foods. One of the few studies that has bridged the gap between ethnobotany and food chemistry was the detailed work by Quin (1959) on food use by the Pedi people. However, a number of studies have been done on the nutrient composition of indigenous plants eaten by tribal people in southern Africa (Levy et al, 1936, van der Merwe et al, 1967, Lewis et al 1971, Shanley and Lewis, 1969, Hennessy and Lewis, 1971, Santos-Oliviera and Carvalho, 1975).

The objectives of this study were firstly to systematically record all foods obtained from indigenous plants on the Maputaland coastal plain, secondly to determine habitual intake of species within this range and thirdly to have analyses done on the nutrient composition of important fruit species. It was beyond the scope of this study to quantify daily food intake as Quin (1959) had done. This information is currently being accumulated by Lind (1984). Nevertheless these data, coupled with the analyses of the nutritional values on indigenous spinaches (Levy et al, 1936, Quin, 1959, Lewis et al, 1971, Shanley and Lewis 1969, Hennessy and Lewis, 1971, Santos-Oliviera and Carvalho, 1975, Gomez, 1982) would enable an assessment of the potential dietary value that indigenous plants could have to rural people in this low agricultural potential area. Seventy-six edible fruit species, twenty-six spinach species and a number of plants used for other dietary purposes were identified. Relatively few of these were commonly collected for household use but these species were important, readily available sources of dietary nutrients.

METHODS

The study area was on the sandy coastal plain of the Ingwavuma district, Natal, South Africa. This low agricultural potential area consists of four ecological zones (Tinley and van Riet, 1981) which closely correlate with the broad vegetation types (Moll, 1978) (Figure 1). The entire study area fell under the control of the Tembe Tribal Authority.

Fieldwork was done between July 1980 and July 1983. After permission for the study had been granted by the Tembe Tribal Authority, the study was carried out in three steps. Firstly, recording all the foods obtainable from indigenous plants (fruits, roots, leaves (for spinach (known in Zulu as imifino)), gum and insects) and their seasonal availability. Insects were included because many larvae were specific to certain woody plants and therefore could also be considered to be a food resource from indigenous plants. Secondly, assessing what species were likely to be the most important in the diet of local people and thirdly, collecting these important species for nutritional analysis. Each of the four ecological zones was visited with various local Zulu or Tembe-Thonga people acknowledged to be local experts on the vegetation. Local names of all edible plant species were recorded and voucher specimens of uncommon or unidentified species were collected and routinely identified at the Bews Herbarium, Natal University (NU). Other collections made in the Maputaland area, namely those of K Balkwill (B),

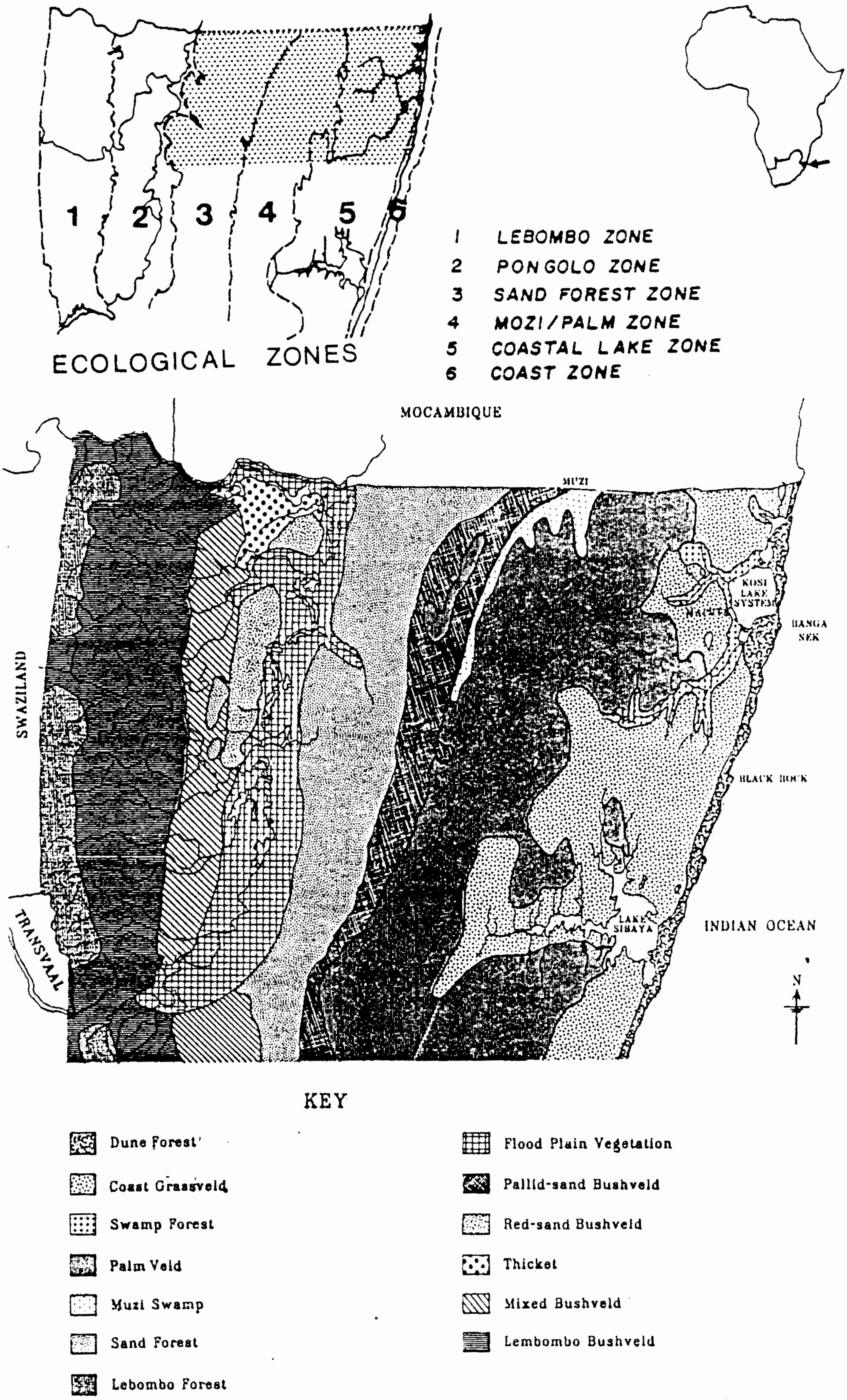


Figure 1: Ecological zones (Tinley and van Riet, 1981) and basic vegetation types (Moll, 1978) of the study area.

P S Goodman (G), E J Moll (M), E S Pooley (P), R Scott-Shaw (SS) and K L Tinley (T) are also cited (Appendix Table 1). Local (Zulu (Z) and/or Tembe-Thonga (T)) names of plant species used in the study area are recorded in a separate study (Cunningham, in prep a). However local names for dishes or items used in food preparation are included in this paper.

The assessments of habitual intake of indigenous plant foods were done by Zulu and Tembe-Thonga field assistants. Two ecological zones (the Mosi-Palm zone and the Coast zone) were sparsely populated or small and were not included in the interview surveys. In the remaining two (Sand Forest and Coastal Lake zones) homesteads were visited by field assistants using a simple questionnaire which allowed for digression and discussion. Sample areas were defined by the KwaZulu Health Department boundaries used by malaria control workers. Population, kraal and hut numbers in these areas were known. Twenty percent (44) of the homesteads in the less densely populated Sand Forest Zone sample area (Health Department sub-units NG 8-10 and S 1-4) and ten percent (73) of the homesteads in the densely populated Coastal Lake Zone sample area (sub-units MP 6-9, KB 1-7) were surveyed. Interviews, producing similar results were also done with 66 craftworkers (in 1980/81) but these data are not presented here.

Nutritional values of popular edible fruit species were obtained from fresh samples collected in the study area and flown to the National Food Research Institute* for analysis whenever possible.

*National Food Reasearch Institute, CSIR
P O Box 395, Pretoria, 0001. S. Africa

RESULTS

A wide variety of edible fruits and spinaches were available from the various vegetation types during different seasons of the year (Appendix Table 1). Seventy-six edible fruit species, twenty-six spinach (imifino) species and two edible gum producing species were identified during the study. Four fruits also had edible kernels ("nuts"), and two tree species produced a sap which was used for curdling milk. Two palm species were tapped for sap to make palm wine. Few fresh fruits were mature between July to September. This overlapped with the "seasonal famine" period when there was least agricultural production and greatest reliance was placed on stored crops or gathered foods. Few fruits or spinaches were stored and virtually all food from indigenous sources were eaten in season. Only two stored fruit species were of any importance. These were *Sclerocarya birrea* kernels and processed *Strychnos madagascariensis* pulp. Between July and September *Parinari curatellifolia* kernels were one of the few indigenous fruits that could be collected in the field that were suitable in terms of abundance, ease of exploitation, palatability and nutritional value. These were restricted to savanna, palmveld and grassland areas and could be collected even after veld burning. Fruit kernels were therefore an important source of protein at this time of the year, but fruits provided little vitamin C or nicotinic acid. Spinaches and palm wine therefore have increased importance as a source of these nutrients because of their year round availability (Appendix Table 1). Perennial spinaches (Asystasia gangetica , Asystasia schimperi,Deinbollia oblongifolia, Pentarrhinum insipidum, Pyrenacantha scandens, and Rorippa fluviatilis) are far more important in this regard than annual species (Amaranthus species, Chenopodium species, Bidens pilosa, Ophioglossum polyphyllum and Sonchus oleraceus) which were only available from wetland fields or moister disturbed areas during winter. Details on fruit and spinach preparation have been included in this section because of the influence this has on nutritional values (see Fox, 1966; Gomez, 1982).

The availability and use of commonly collected fruit species varied between the two ecological zones at either side of the coastal plain as well as with season (Figures 2 and 3). Syzygium cordatum trees were restricted to high water-table sands near the coast or in the Mosi-Palm Zone. Salacia leptoclada and Lagynias lasiantha were restricted to the Sand Forest Zone while other trees (eg. Manilkara concolor and M.discolor) commonly occurred in the Sand Forest Zone but also grew in scattered patches of Dry or Evergreen Coast Forest in the Coastal Lake Zone. Food selection and the range of species used reflect this change in the availability of these fruit species (Figures 2 and 3). Most fruits were collected and eaten raw, either in the field or as a supplement to the main meal at the homestead. A few species were specially prepared or were added to the starchy staple foods. These were Trichilia emetica (arils), Strychnos madagascariensis pulp, kernels of Sclerocarya birrea, Parinari curatellifolia,

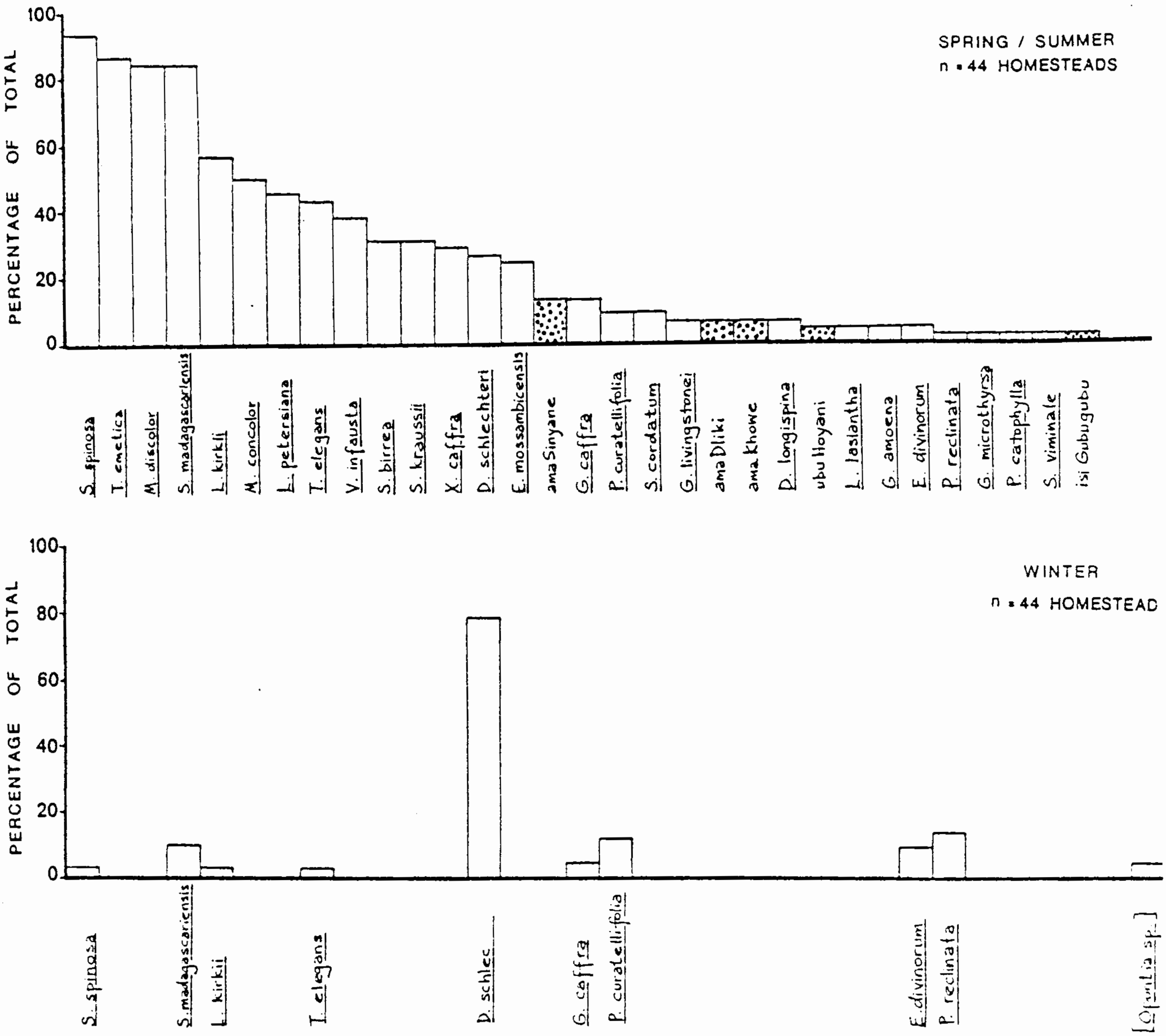


Figure 2: Edible fruits and fungi collected for home consumption by respondents at 44 different homesteads in the Sand Forest Zone during spring/summer (September - February) and "winter" (June - August).

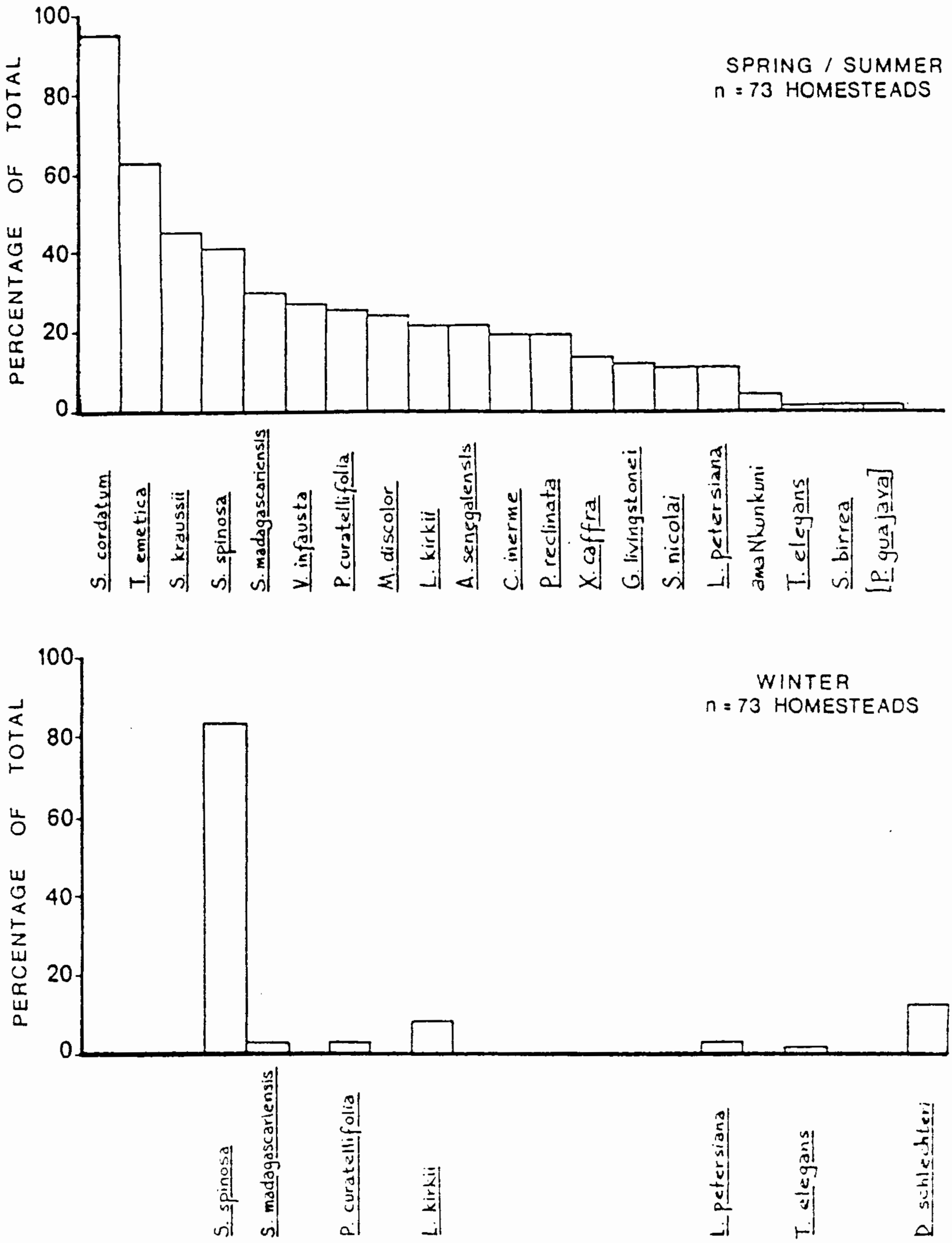


Figure 3: Edible fruits collected for home consumption by respondents at 73 different homesteads in the Coastal Lake Zone during spring/summer (September - February) and "winter" (June - August). No respondents in this ecological zone said that they collected fungi.

Ximenia caffra and Balanites maughamii and fruits of Sarcostemma viminale, Landolphia kirkii, L.petersiana, Strychnos spinosa, Ximenia caffra, Canthium inerme, Dialium schlecteri, Lagynias lasiantha and Vangueria infausta.

Preparation

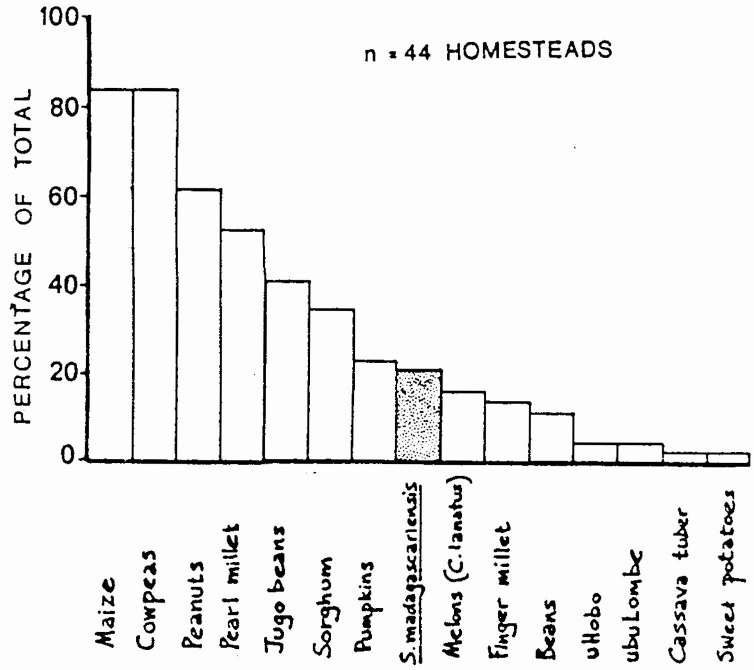
a) Trichilia emetica arils. The seeds were removed from the capsule and soaked in water until the aril changed colour from orange to light yellow. The seeds were then separated from the arils. Seeds were not edible (very bitter) but may be kept for their oil, which was sometimes used to treat skins and used to be exchanged with the Portugese in Mozambique for salt. The arils were then mixed with the main meal (usually with sweet potatoes (Ipomaea batatas) or with squash (Citrullus lanatus) and peanut (Arachis hypogaea) flour) after these have been prepared.

b) Strychnos madagascariensis. The pulp of this fruit is often bitter and was not usually eaten unprepared. However fruits were collected in large quantities to prepare anFuma (T) or ubuKwakwa (Z) from the processed pulp as this was sometimes sold during winter to provide income. After collection the fruit shells were broken open and the seeds and pulp were removed. These were dried over a fire on mats made of woven laths (isiCabha (Z), ashiCabha or ashiHandu (T)) over a pit (ashiYani

(T)) or a circular structure about one metre high. Particular hardwood species are selected for preparing the pulp as sooty smoke would discolour the pulp and make it bitter. Newtonia hildebrandtii and Pteleopsis myrtifolia wood was particularly favoured as it burnt without producing smoke. Other species that were used are: Acacia burkei, Albizia adianthifolia and A.versicolor (not popular), Combretum molle, Dialium schlecteri, Hymenocardia ulmoides, Sclerocarya birrea, Strychnos madagascariensis, Syzygium cordatum and Terminalia sericea wood. When the pulp had changed to an orange-brown colour, but was still moist, it was separated from the pips with a sharp, flat instrument. It was then placed on a sleeping mat on a skin and dried in the sun before being dried over the fire again. This dried pulp was then stamped in a wooden mortar and was sometimes mixed with honey or sugar. In this state it will last up to five years in storage (Figure 4).

c) Kernels of seeds (Sclerocarya birrea, Parinari curatellifolia, Ximenia caffra and Balanites maughamii).

All of these could be stored inside the seed and were cracked open to obtain the edible kernel. S.birrea kernels were the most popular, because of their palatability and because they were available in large



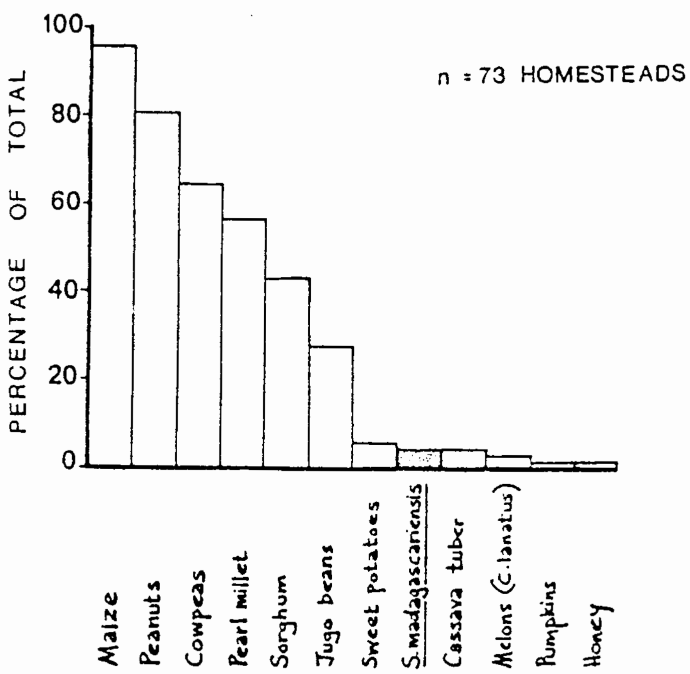


Figure 4: Foods stored by respondents in the Sand Forest (A) and Coastal Lake (B) zones of the study area. Apart from smoked *Strychnos madagascariensis* pulp (shaded) all other stored foods were cultivated crops.

Figure 5: Most homesteads have rocks that have been brought onto the sandy coastal plain from the Pongolo floodplain or Lebombo areas in order to grind tobacco or crack *Sclerocarya birrea* seeds. Repeated cracking of the seeds causes the characteristic pitted surface on these hard rocks. The rock shown in the figure had been in use for 40 - 50 years.

quantities. Female S.birrea trees have high fruit yields and piles of seeds remained after beer was brewed from the fruits. Despite the disadvantage of their hardness, local women were very skilled at cracking the seeds. Parinari curatellifolia seeds were also frequently used and were easier to crack. Their main disadvantage was that they caused flatulence. B.maughamii and X.caffra seeds were rarely used because of their relative scarcity and they were less palatable.

The kernels of the seeds were removed after the seeds were cracked on a rock specially kept for this purpose (Figure 5). The kernel (or two to three in S.birrea seeds) was then removed with a sharp instrument (a pin or a thorn). S.birrea and P.curatellifolia kernels may be eaten raw but were usually ground into a flour and cooked with spinach as a substitute for peanut flour.

d) Sarcostemma viminale fruits. These may be eaten raw, but were also sometimes boiled.

Other species were added as pulp to porridge or used to curdle milk. Three types of porridge may have fruit added. These were:

i) umBila (Z) (= anBila or ashiManga (T)) which was made from maize or pearl millet meal with the addition of pulp from Canthium inerme, Dialium schlecteri, Lagynias lasiantha or Vangueria infausta fruits.

ii) iNhlama (Z) porridge which was made by leaving this umBila to go sour

iii) amaHewu (Z) which was a slightly fermented porridge, made in the same way as umBila to which Canthium inerme fruits were added as a sweetener instead of sugar

iv) iDokwe-lamahlala which was a cooked porridge which is left to ferment after Strychnos spinosa fruit pulp had been added to give a sour taste

Sour milk was consumed mainly by herdboys. Three types were made by adding fruit pulp or sap to the large gourd (iGula) in which the sour milk was made. These were:

a) aMasi (Z) which is a stiff curdled milk. This may have the root of Oxygonum dregeanum* (amDambani) added to curdle the milk although the root itself is not edible

b) iKluhlwani (Z) (=anKluhlwani) (T)) which is jelly-like. This was quickly made by adding a few drops of Tabernaemontanta elegans or Voacanga thouarsii sap .

* (Cunningham, NU, 801)

Milk may also have fruits of *Landolphia kirkii*, *L.petersiana*, *Strychnos spinosa* or *Ximenia caffra* added to make it sour. This is also generally known as *aMasi* (Z).

Indigenous fruits may also be fermented to make beer or used in unfermented drinks. The most commonly consumed alcoholic beverage in the area was palm wine, made from fermented sap from *Hyphaene natalensis* and *Phoenix reclinata* (see Cunningham, in prep b). Apart from *Sclerocarya birrea* beer which was only available in February - March, the rest of the beers made from fruit (Table 1) were rarely made.

Non-fermented drinks were made from the fruits of *Manilkara discolor*, *Manilkara concolor*, *Salacia kraussii*, and *Pappea capensis* without the addition of sugar, and from *Landolphia kirkii* and *Landolphia petersiana* with sugar added to water and fruit pulp. The fruits were simply put in water and the pulp squeezed off the pips. The pulp (depending on the preference of the person) may or may not be discarded before drinking.

Spinaches (imifino)

Spinaches were most abundant in recently disturbed areas. Exceptions were *Asystasia gangetica*, *Asystasia schimperi*, *Deinibollia oblongifolia* (a shrub) and *Pyrenacantha scandens* which grow on forest margins as well as on fallow agricultural lands. Use and availability of indigenous spinaches also

TABLE 1: Indigenous fruits and palm sap used for making alcoholic beverages in the study area. Beers were also made from agricultural crops (melons, paw-paws, maize, sorghum and millet (*Eleusine* and *Pennisetum*)) but these have been excluded from the table.

SPECIES	BEVERAGE (local name)	PREPARATION
Garcinia livingstonei	ubuPhimbi	Fruits soaked, pips and skins are removed, then it is cooked before fermentation, otherwise it it bitter.
Hyphaene natalensis (sap)	ubuSulu (iNjemane)	sap tapped from the cut stump (see Cunningham, in prep b)
Manilkara discolor	ubuNwebe	fruits (fermented) in water
Manilkara concolor	?	fruits (fermented) in water
Phoenix reclinata	?	fruits (fermented) in water
Phoenix reclinata (sap)	ubuSulu (iNjemane)	sap tapped from cut stump (see Cunningham, in prep b)
Sclerocarya birrea	ubuGanu	fruits soaked, pips and sometimes skin removed. Then fermented skimming off foam as it builds up after 2 - 3 days.
Syzygium cordatum	ubuDoni	same as above

varied between seasons and the different ecological zones (Figures 6 and 7). Some spinaches grew commonly in the drier Sand Forest Zone (eg. Momordica balsamina and Cucumella cinerea) and were seldom available in the other ecological zones. Conversely, species such as Deinbollia oblongifolia commonly occurred in the Coastal Lake Zone but were only used when the more palatable species were not available and were therefore not recorded from interview data in this zone (see Figure 7). Similarly, Asystasia gangetica grew in the moister Coastal Lake Zone and was not recorded as part of the habitual intake of people in the Sand Forest Zone (Figure 6). Leaves of Pyrenacantha scandens and Deinbollia oblongifolia were less frequently used in summer because of their fibrous leaves. However, their use increased in winter when annual spinach species died back in fallow dryland fields. At this time palm shoots (umHlenga) from Hyphaene natalensis and Phoenix reclinata were collected in the Mosi-Palm Zone and eaten raw or cooked.

Preparation

Most spinaches were cooked although some (Asystasia gangetica, Pentarrhinum insipidum and Rorippa fluviatilis) could be eaten raw in small quantities. Most spinaches are boiled twice, discarding the water each time. This is optional, but necessary to reduce the bitter taste of many species (eg. P.insipidum and Pyrenacantha scandens). Boiling time depends on the species and the type of dish being prepared. R.fluviatilis and Bidens

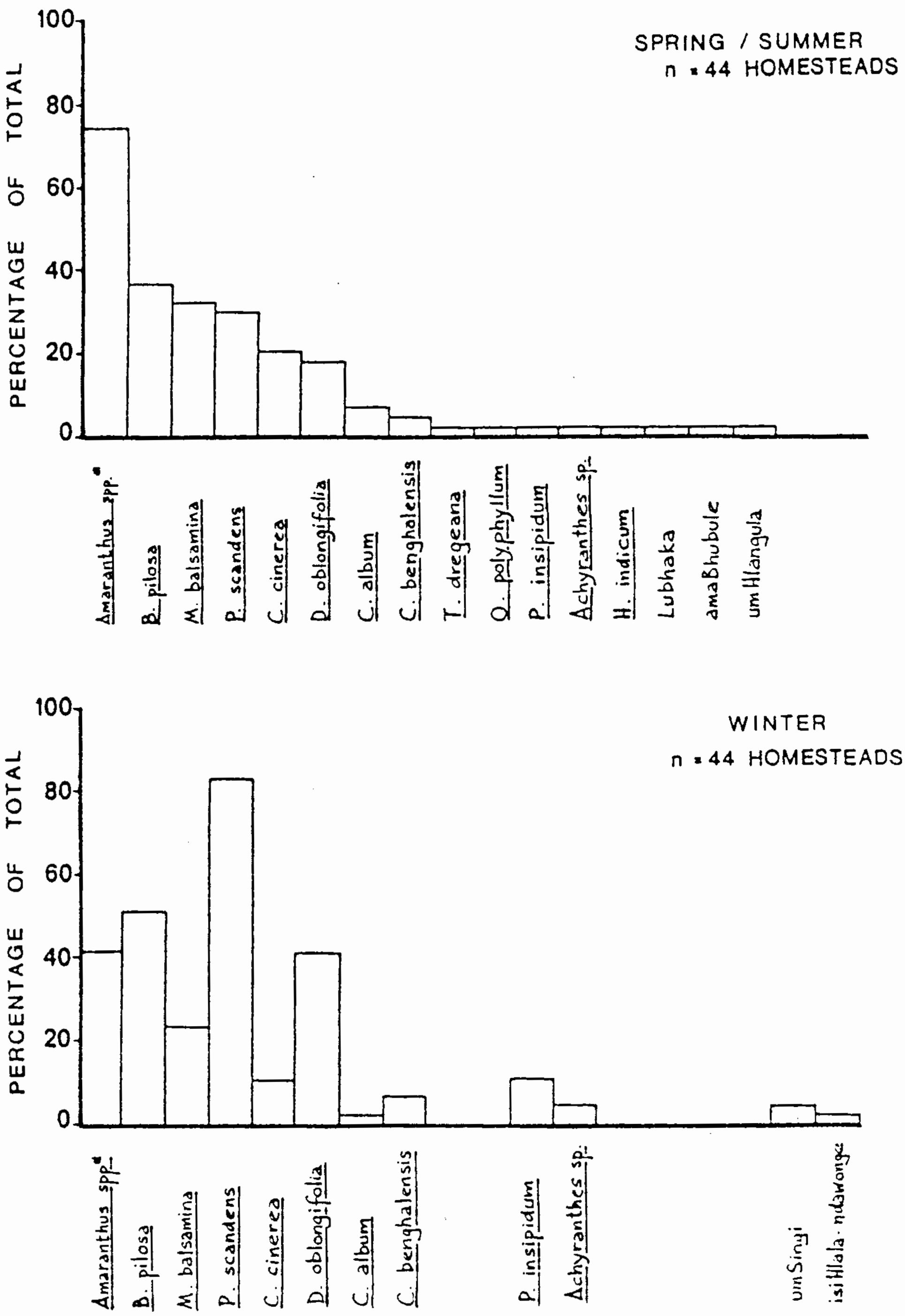
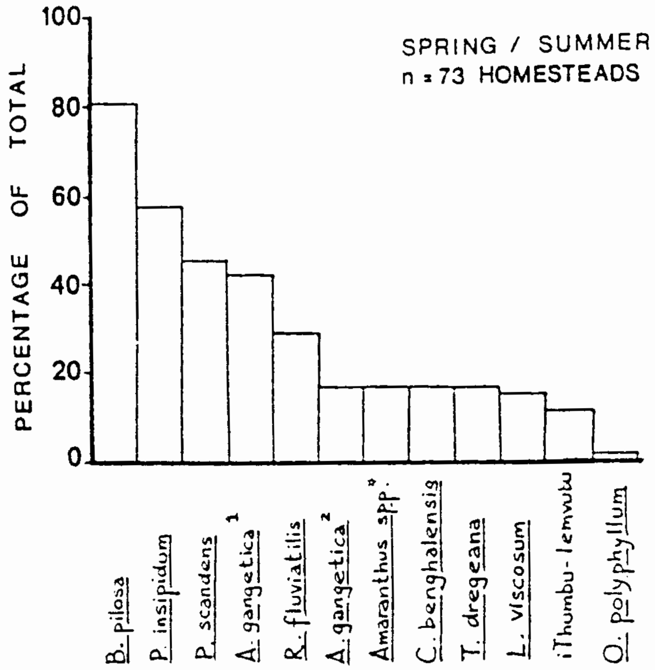


Figure 6: Edible indigenous spinaches (imifino) collected for home consumption by respondents at 44 different homesteads in the Sand Forest Zone.



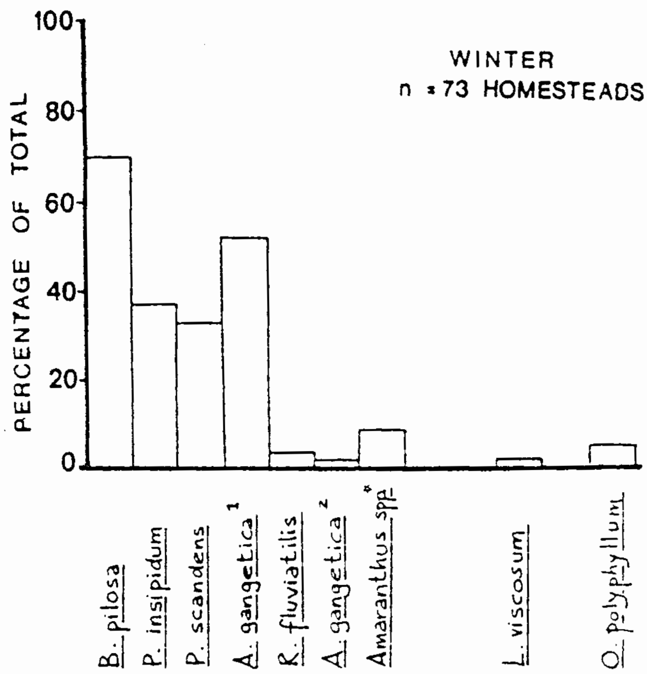


Figure 7. Edible indigenous spinaches (imifino) collected for home consumption by respondents at 73 different homesteads in the Coastal Lake Zone. Because A.gangetica may be a complex of different species , the two forms have been separated in this figure. Each was known by a different local name. The fleshy leaved type, occurring seaward facing coastal dunes (A.gangetica^{2} = Balkwill, NU 196) was called umaDitingwane. A less robust type, growing on forest margins and in fallow fields (A.gangetica^{1}). Cunningham, NU 700) was called isiHobo. Amaranthus spp * were not possible to separate from interview data as they were all known by one name (iSheke).

pilosa break down very rapidly and were first boiled for a very short time (about five minutes) before the water was poured off. More fibrous species were boiled for longer (Figure 8). If spinach was to be eaten with sweet potatoes or maize meal, it was boiled for a shorter time than if cooked with peanut flour.

Roots. The only roots eaten for dietary purposes were from Commiphora neglecta. These have a slightly sweet taste (younger plants) and were also eaten to quench thirst in the dry Sand Forest Zone. They were also usually eaten in the field. The roots of a climber, Mondia whitei (uMonde) which grows in Swamp Forest in the Coastal Lake Zone were eaten by people throughout the area to improve their appetite. This was classed as a medicinal use of the plant.

Fungi. Fungi were collected for home consumption (Figure 9) but were probably not significant in the diet (Figure 2). Twelve varieties of fungi were known locally. The most popular of these (amaSinyane, amaDliki, amaKhowe, ubuHayane and uNugane) were collected during this survey. Seven additional types were recorded. Six by Felgate (1965, 1982)(iziHangwane, amaKhawethambu, iziPhangalazane, iziTlidliki, imiWashane and inKonkawane) and one (isiGubugubu) in this study. No botanical names are currently available for specimens of fungi collected (Cunningham, 781, 782, 783). All fungi were either boiled or could be dried and stored for later

Figure 8: A common problem with cooking indigenous spinach species (in this case Pyrenacantha scandens leaves) is that they are fibrous and removal of these "stringy" pieces is a time consuming process.

Figure 9: Unidentified fungi (amaDliki) collected for home consumption in the Sand Forest Zone.

use (particularly amaSinyane). At least one species (uNugane) could also be eaten raw. Dried fungi were ground up and added to flavour soups made with peanut flour and spinach. Most fungi were collected after the spring rains (October-November) but were still available until April-May.

Insects. Edible insects are given in Table 2. The four commonly collected types of insect larvae that were specific to one or a few indigenous plants are shown in Figure 10. Saturniid larvae abundance varies markedly between different years. Microgone cana larvae which were exceptionally common in 1980 to the point of defoliating parts of their foodplant (Syzygium cordatum) were very scarce in 1981, 1982 and 1983. This may also be the case with Bunea alcinoë and other Saturniid larvae. Insects, due to their appearance, were avoided as a source of food by many people in the area. Insect larvae were usually cooked in their own fat or in oil. Saturniid larvae were sometimes dried for storage (in the Sand Forest Zone). In common with fruits, insect availability depended on vegetation type and the abundance of the specific foodplants.

NUTRITIONAL VALUES

Table 3 and Appendix Table II summarise the data on nutrient composition of fruits eaten in the study area. Data from other published studies has been included in Appendix Table I for comparitive purposes in the discussion.

TABLE 2: Edible insects eaten in the study area listing the food plants recorded. Saturniid larvae, and flying sexual stages of termites and ants were available seasonally in September-October (Saturniidae) and after spring and summer rains (ants and termites).

FAMILY	SPECIES	STAGE	LOCAL NAME	FOODPLANT	REFERENCE
Apidae	*Apis mellifera*	larvae and honey	iNyosi	See discussion	3, 4
	Trigona becarii	honey	iMbonga		3, 4
	Trigona gribodoi	honey	iMbongalolwane		3, 4
Cerambycidae	*Mallodon downesii*[1] *Plocoderus frenatus*[1] Unidentified spp	larva	iMpunge	*Acacia robusta* *Sclerocarya birrea*	1, 3, 4
Curculionidae	*Rhynchophorus phoenicus* (?)	larva	iFilitsha	*Hyphaene natalensis* *Phoenix reclinata*	4
Formicidae	*Carebara vidua*	adults (male and female)	amaHlwabusi	-	2, 3, 4
Locustidae	*Locusta* sp Unidentified sp	adults and late instar "	iQhwagi iNtethe	More common in Coastal grasslands and palmveld. No specific foodplant	4
Saturniidae	*Bunea alcinoë*	larva	iCimbi	*Ekebergia capensis*	4
	Microgone cana	larva	iCimbi	*Syzygium cordatum*	4
Scarabaidae	Unidentified sp	adult	iNdokondela	*Hyphaene natalensis*	4
Termitidae	*Macrotermes* spp	adults	ubuShashane	-	4
Vespidae	Unidentified sp	larva	iNyonovi	-	4

References: 1. Junod (1927). 2. Poultney (1980). 3. Pooley (1980). 4. This study.

Figure 10: Phytophagous insects commonly eaten by rural people on the Maputaland coastal plain that were restricted to one or a few woody plant species. A. Cerambycid larvae from Sclerocarya birrea dead-wood. B. Cerambycidae from Acacia robusta dead-wood. C. Larvae of Microgone cana (Saturniidae) feeding on Syzygium cordatum leaves. D. Unidentified larva (iFilitsha) from Hyphaene natalensis (possibly a larva of Rhynchophorus phoenicus (Curculionidae)).

Table 3. Nutrient composition of indigenous foods eaten in the study area (see also Appendix Table II). All figures expressed per 100 g (fresh weight).

SPECIES	g/100 g						Kj/100 g	mg/100 g													
	MOISTURE	ASH	PROTEIN	FAT	FIBRE	CHO	ENERGY VALUE	Ca	Mg	Fe	Na	K	Cu	Zn	Mn	P	Thia-min	Ribo-flavin	Nico-tinic acid	Vit.C	Caro-tene
Landolphia kirkii	67.9	0.8	1.3	1.3	1.1	27.6	535	2.31	13.6	1.02	8.07	347	0.12	0.13	0.19	25.0	0.05	0.05	1.12	18.4	α=0.0041 β=0.0093
Landolphia petersiana	75.5	0.6	0.9	0.4	0.9	21.7	395	4.29	9.06	0.59	5.13	250	0.14	0.26	0.19	15.7	0.04	0.01	1.15	36.1	α=0.00047 β=0.00093
Ximenia caffra	79.3	1.6	2.3	0.7	0.3	15.8	331	2.17	15.1	0.21	1.79	508	0.12	0.18	0.35	31.0	0.04	0.004	0.54	55.9	trace
Inhambanella henriquesii	75.4	1.4	2.6	1.7	1.9	17.0	394	41.8	25.5	0.6	2.18	606	0.19	0.22	0.25	30.4	0.07	0.06	1.10	238	trace
Manilkara discolor	71.0	1.3	2.1	1.9	2.1	21.6	470	81.9	26.5	0.75	4.97	474	0.13	0.25	1.98	23.6	0.04	0.04	0.35	12.4	α=0.00014 β=0.0017
Manilkara concolor	71.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.1	α= - β=0.0031
Eugenia capensis subsp albanensis	85.9	0.7	0.8	0.2	3.0	9.4	179	31.0	12.0	0.48	32.31	197	0.05	0.09	0.23	10.0	0.01	0.01	0.35	24.4	α= - β=0.0013
Salacia kraussii	84.7	0.4	1.1	0.2	0.6	13.0	245	10.4	23.5	0.25	2.43	141	0.12	0.10	0.36	15.3	0.01	0.02	0.77	7.6	α=0.0006 β=0.0039
Vangueria infausta	48.6	2.4	2.1	0.05	6.8	40.1	710	38.6	45.0	0.81	8.95	797	0.13	0.11	1.53	52.4	0.09	0.01	0.71	-	-
Dialium schlechteri	6.7	3.8	4.8	0.1	5.2	79.4	1 418	36.8	59.6	2.07	30.1	1 694	1.75	2.19	2.53	224	0.29	0.06	2.89	-	-
Phoenix reclinata	19.0	3.2	4.1	0.7	9.3	63.7	1 166	41.0	57.4	1.83	93.27	1 206	0.42	0.59	1.03	35.1	0.03	0.03	1.48	-	-

DISCUSSION

In the 1960's, Felgate (1965, 1982) observed that "the striking feature of Thonga subsistence activity is that food collecting and agriculture play an equally important role in the Thonga subsistence economy. They cannot be described purely as agriculturalists". There are two main reasons for this, firstly environmental, and secondly sociological. The sandy soils have a low agricultural potential and are susceptible to drought (Loxton et al 1969). However there is a high diversity of edible plant species available. This is primarily because Maputaland lies within a replacement-transition zone where there is an overlap in the distribution of sub-tropical and temperate species (see Bruton and Cooper, 1980). The excellent botanical knowledge of the Thonga people commented on by Junod (1927) and Pooley (1980) can be seen as a reflection of this diversity. Apart from edible seaweeds (<u>Digenia simplex</u> and probably <u>Gracilaria</u>, <u>Codium</u>, <u>Laurencia</u>, <u>Porphyra</u> and <u>Ulva</u> species) (see Seagrief, 1980 and FAO, 1972), palm wine from <u>Raphia australis</u> and possibly some roots and tubers, most of these edible foods are known. The sociological reasons revolve around the low socio-economic status of these subsistence farmers and their attitudes to gathering of indigenous fruits, spinaches and insects. In common with most people in developing countries who are changing from a subsistence to a consumer way of life, attitudes to food gathering are rapidly being altered. This was apparent to

Tembe-Thonga people in the study area at least twenty years ago when Felgate (1965, 1982) recorded that :-

"Old men and women frequently lament the fact that the younger generation are losing the art of cooking. A number of informants have gone so far as to say that the ground has lost its fertility and it no longer rains as it used to rain, because women "live in the store" - meaning by this that the whole order of things has been upset by the fact that women rely too heavily on bought maize. These old people say that the children in their day were not sick and hungry as they are today, because the women in those days knew better how to gather food from the forests and from the veld".

Felgate (1965, 1982) considered that this was "probably an idealization of the past". However Scudder (1971), Doughty (1979), Grivetti (1979) and Fleuret and Fleuret (1980) have all stressed the importance of dietary diversity and indigenous plant foods in human nutrition.

Data on the nutrient composition of gathered foodstuffs gives a better basis for evaluating the role that these foods could play in the diet of rural people in the study area. However consideration of the nutrient composition of the foodstuffs in Appendix Table II gives a little insight into their dietary importance. The nutrients in each fruit, spinach or insect species cannot be compared in isolation. Comparison of the nutritional values of the fruits with a known standard also gives a distorted idea of their dietary importance, either because they are rarely available or because of the quantities consumed. For example Inhambanella henriquesii fruits contain about eight times the amount of vitamin C per 100 g than an orange. This is the highest vitamin C content of any southern African indigenous fruit species analysed to date. Yet despite their palatability and popularity they were insignificant as a source of vitamin C in the diet of rural people in the area as I.henriquesii trees were restricted to rapidly disappearing areas of mature forest and were rarely consumed. In contrast, the vitamin C content of palm wine only contained about a tenth of that in orange juice but was regularly consumed in large enough quantities to be considered to be an important source of vitamin C in the area (see Cunningham and Wehmeyer, in prep).

In common with subsistence agriculturalists elsewhere, rural people living in Maputaland have a starchy staple diet of cereals and pulses (see Felgate, 1965, 1982, Poultney, 1980). These starchy diets are often deficient in nicotinic acid (niacin), vitamin C (ascorbic acid), riboflavin, calcium (Groenewald et al, 1981, Beyers et al, 1984) protein and energy (Margo et al, 1976). Deficiencies of retinol (vitamin A)(derived from beta-carotene in plants) and thiamin (vitamin B), may also be present (Passmore et al, 1974).

A major question about the value of indigenous plants as a food source (ie. fruits, insects and spinaches) is whether they are of primary or supplementary importance to the diet of rural people.

Their most important role would be the extent that they compliment the starchy staple diet. Indigenous plants eaten in the study area were known from previous studies to be a source of some of these nutrients. Particularly important were nicotinic acid from spinaches (Lewis et al, 1968, Hennessy and Lewis, 1971, Santos-Oliviera and Carvalho, 1975) and palm wine (Heard, 1955, Felgate, 1965, 1982, Nash and Bornmann, 1973), protein from phytophagous insects (Quin, 1959) and the kernels of Sclerocarya birrea fruit (Quin, 1959; van der Merwe et al, 1967), riboflavin from caterpillars (Fox, 1966) and vitamin C from spinaches (Gomez, 1982) and fruits (Quin, 1959, Wehmeyer, 1966 , van der Merwe et al, 1967).

It was considered that the nutritional composition of commonly collected foodstuffs compared on the basis of daily ration size against the most recent Recommended Dietary Allowance (RDA) requirements (Anon, 1979) would give a better basis for assessing their potential dietary value. Approximate daily ration sizes were obtained from intake data collected by Quin (1959), Colman et al (1975), and Oomen and Grubben (1977). Field observation and discussion with local women confirmed that these were good estimates of normal daily ration sizes for foodstuffs eaten in the study area (see Appendix Table III).

The potential dietary role that commonly available indigenous plants could play as a source of foods complimenting the starchy staple diet are shown in Tables 4 to 9. In each case, the RDA requirement for an adult female was used (Anon, 1979). However the use of RDA requirements for children or an adult male would not make major changes in interpretation of the nutrient composition of the foodstuffs. Two species that were popular but not commonly eaten in the study area were *Inhambanella henriquesii* fruits and *Trapa natans* kernels. These have been included in Tables 4-9 for comparitive purposes. In common with any dietary evaluation there are numerous limitations to this. Firstly, there are limitations to the use and interpretation of RDA's (Hegsted, 1972, Passmore et al, 1974). Secondly, the intake of food resources from indigenous plants varies with vegetation type, season, religious preferences, social attitudes to gathering and the sex or age of the family member. For example, members of the Zionist sect do not drink palm wine or Zulu beer (utchwala). Most men eat meat and drink beer and palm wine more regularly than women and children, but eat less spinach, while the children (and particularly herd-boys) eat the complete range of edible fruits and insects available. During drought periods or "seasonal hunger" people living in the coastal grasslands (which have poor quality soils) relied heavily on indigenous plants for food. This was also the case with old people who are unable to cultivate large fields. In both cases, indigenous spinaches, fruits and the kernels of *Sclerocarya birrea* and *Parinari curatellifolia* seeds form a high portion of daily intake. At the otner extreme people with a more "modern" attitude who scorn the use of gathered

Table 4 Protein. Potential value per portion of commonly collected food sources from indigenous plants compared with typical foods used in the study area. Numbers in brackets after each food item represent the fraction of the RDA requirement (44 g) in each food portion. (ie. 100% RDA in food portion = 1.0, 80% RDA = 0.8 etc). Food portions for each item are given in Appendix III.

RATING OF DIETARY VALUE IN DAILY INTAKE	FOODSTUFF						
	SPINACH	FRUIT, NUT FUNGUS	BEER	STAPLE	MEAT	MILK	INSECT
PRIMARY SOURCE (>80% RDA)		_S.birrea_ kernel (1.05) (_P.curatellifolia_ kernel?)		Peanut (1.19)* Cowpea (1.12)* Jugo bean (0.81)*	Fish (1.41	Milk (1.79)	Caterpillars (3.0)
GOOD SUPPLEMENT (60 - 79% RDA)				Sorghum (0.71)* Pearl millet (0.79)*	Mussels (0.78) Beef (0.70)		Locusts (0.69)
MODERATE SUPPLEMENT (40 - 59% RDA)	_M.utilissima_ (0.48)* _A.spinosus_ (0.41)						Caterpillar (Saturniidae _G.belina_) (0.52)
POOR SUPPLEMENT (20 - 39% RDA)	_A.hybridus_ (0.32) _A schimperi_ (0.37) _A.thunbergii_ (0.37) _C.album_ (0.32) _I.batatas_ (0.29)* _M.balsamina_ (0.25) _O.polyphullum_ (0.24)	_T.natans_ kernel (0.21) Cashew nut (0.39)	uTchwala (Zulu beer)(0.32)				
INSIGNIFICANT SUPPLEMENT (20% RDA)	_L.vulgaris_ (0.16)* _B.pilosa_ (0.15 - 0.28)	_E.capensis albanensis_ (0.05) _D.schlecteri_ (0.05) _I.henriquesii_ (0.09) _L.kirkii_ (0.09) _L.petersiana_ (0.06) _M.discolor_ (0.14) _P.reclinata_ (0.09) _P.curatellifolia_ (0.07) _S.kraussii_ (0.08) _S.spinosa_ (0.09) _S.birrea_ (0.03) Banana (0.08)* Mango (0.05)* Mushrooms(0.03)	ubuSulu (palm wine)(0.09) ubuGanu (_S.birrea_ fruit beer) (0.08)	Melon (_C.vulgarils_)* (0.15) Cassava (0.05)* Maize (0.15)*			Ants (_amaHlwabusi_) (_C.vidua_) male (0.17) female(0.05)

*Cultivated plant

* Cultivated plant [illegible]

Table 5 Calcium. Potential value per portion of commonly collected food sources from indigenous plants compared with typical foods used in the study area. Numbers in brackets after each food item represent the fraction of the RDA requirement (800 mg) in each food portion. (ie. 100% RDA in food portion = 1.0, 80% RDA = 0.8 etc). Food portions for each item are given in Appendix III.

RATING OF DIETARY VALUE IN DAILY INTAKE	FOODSTUFF						
	SPINACH	FRUIT, NUT FUNGUS	BEER	STAPLE	MEAT	MILK	INSECT
PRIMARY SOURCE (>80% RDA)	*A.spinosus* (1.41) *A.thunbergii* (0.82 - 2.74) *B.pilosa* (1.09) *C.album* (0.9) *I.batatas* (1.35)* *M.utilissima* (1.14) *M.balsamina* (1.13)			Finger millet (0.86)*		Milk (3.42)	Caterpillars (dried)(0.81)
GOOD SUPPLEMENT (60 - 79% RDA)							
MODERATE SUPPLEMENT (40 - 59% RDA)	*C.antiquorum* (0.48)* *S.oleraceus* (0.56)				Mussels (0.5)		
POOR SUPPLEMENT (20 - 39% RDA)	*L.vulgaris* (0.3)*	*M.discolor* (0.31) *P.curatellifolia* (0.22) *S.spinosa* (0.24)			Fish (*Mugil* sp) (0.21)		
INSIGNIFICANT SUPPLEMENT (<20 % RDA)		*E.capensis* subsp. *albanesis* (0.12) *D.schlecteri* (0.02) *I.henriquesii* (0.16) *L.kirkii* (0.008) *L.petersiana* (0.02) *P.reclinata* (0.05) *S.kraussii* (0.04) *S.birrea* (0.02) *S.birrea* kernel (0.19) *S.madagascariensis* dried pulp (0.06) *S.cordatum* (0.11) *T.natans* kernel (0.05) Banana (0.03)* Mango (0.04)* Cashew (0.05)*	ubuSulu (palm wine)(0.02) ubuGanu (*S.birrea* fruits) (0.1) uTchwala (Zulu beer)(0.02)	Maize meal (C)* (0) Peanuts (0.18)* Cowpea (0.18)* Sorghum (0.12)* Pearl millet (0.16)* Cassava (0.13) Jugo bean (0.16)* Melon (*C.vulgaris*) (0.09)	Beef (0.02)		Locusts (0.19)

* Cultivated plant

* Cultivated plant

Table 6 Riboflavin. Potential value per portion of commonly collected food sources from indigenous plants compared with typical foods used in the study area. Numbers in brackets after each food item represent the fraction of the RDA requirement (1.2 mg) in each food portion. (ie. 100% RDA in food portion = 1.0, 80% RDA = 0.8 etc). Food portions for each item are given in Appendix III.

RATING OF DIETARY VALUE IN DAILY INTAKE	FOODSTUFF						
	SPINACH	FRUIT, NUT FUNGUS	BEER	STAPLE	MEAT	MILK	INSECTS
PRIMARY SOURCE (>80% RDA)	M.utilissima (1.5)*		uTchwala (Zulu beer)(1.0)	Cowpea (1.41)		Milk (3.01)	Caterpillars (dried)(4.1)
GOOD SUPPLEMENT (60 -79%)	I.batatas (0.6)* (other spinach species Amaranthus ? Asystasia ?)						
MODERATE SUPPLEMENT (40 - 59% RDA)	B.pilosa (0.58) C.album (0.58)	P.curatellifolia (0.45) S.cordatum (0.58)		Sorghum (0.48) Pearl millet (0.4)			
POOR SUPPLEMENT (20 - 39%)		T.natans kernel (0.2) Cashew nut (0.21)*		Peanuts (0.21) Melon (0.2)	Fish (Mugil sp)(0.38) Beef (0.28)		
INSIGNIFICANT SUPPLEMENT (<20% RDA)		E.capensis subsp. albanensis (0.03) D.schlecteri (0.03) I.henriquesii (0.15) L.kirkii (0.05) L.petersiana (0.03) M.discolor (0.1) P.reclinata (0.03) S.kraussii (0.05) S.birrea (0.13) S.birrea kernels (0.15) S.madagascariensis dried pulp (0.03) S.spinosa (0.18) V.infausta (0.03) X.caffra (0.01) Banana (0.15) Mango (0.13) Mushroom (0.19)	ubuSulu (palm wine)(0.17)				

* Cultivated plant

Table 7 Nicotinic Acid (niacin). Potential value per portion of commonly collected food sources from indigenous plants compared with typical foods used in the study area. Numbers in brackets after each food item represent the fraction of the RDA requirement (13 mg) in each food portion. (ie. 100% RDA in food portion = 1.0, 80% RDA = 0.8 etc). Food portions for each item are given in Appendix III. Arrows represent increased anti-pellagragenic properties due to high tryptophan content.

RATING OF DIETARY VALUE IN DAILY INTAKE	FOODSTUFF						
	SPINACH	FRUIT, NUT FUNGUS	BEER	STAPLE	MEAT	MILK	INSECTS
PRIMARY SOURCE (>80% RDA)				Sorghum (0.9•)◆ Peanuts (6.7)	Fish (Mugil spp) (1.06)		Caterpillars (dired)(2.06)
GOOD SUPPLEMENT (60 - 79% RDA)			uTchwala (Zulu beer)(0.76)	Pearl millet (0.74)•◆			
MODERATE SUPPLEMENT (40 - 59% RDA)	M.utilissima •(+) (0.55)		ubuSulu (palm wine)(0.43)				
POOR SUPPLEMENT (20 - 39%)	A.hybridus (0.29) A.spinosus (0.26) A.schimperi (0.25) C.antiquorum (0.20)• I.batatas (0.39) • O.polyphyllum (0.3)	I.henriquesii (0.25) L.kirkii (0.26 L.petersiana (0.26) S.spinosa (0.23) Mango • (0.25)		Jugo bean•◆ (Bambarra ground-nut) (0.3)	Beef (0.27)		
INSIGNIFICANT SUPPLEMENT (<20% RDA)	B.pilosa (0.18) C.album (0.16)	S.birrea (kernel)(0.8) E.capensis subsp. albanensis (0.08) D.schelcteri (0.11) M.discolor (0.08) P.curatellifolia (0.12) P.reclinata (0.11) S.kraussii (0.18) S.birrea (0.05) S.madagascariensis dried pulp (0.12) S.cordatum (0.03) T.natans kernels (0.09) V.infausta (0.05) X.caffra (0.12) Banana (0.16) Cashew nuts (0.14)• Mango (0.25)• Mushroom (0.16)		Melon (C.vulgaris)• (0.07) Maize meal (c)(0.03)•◆ Peanuts (0.03)•◆ Cassava (0.16)•◆ Finger millet (0.16)•◆		Milk (0.14)	

• Cultivated plant (+) Can contain cyanide (see Lancaster and Brooks, 1983), therefore not a recommended source of niacin unless detoxified
◆ Nicotinic acid unavailable for assimilation (niacytin)

Table 8 Vitamin C (Ascorbic acid). Potential value per portion of commonly collected food sources from indigenous food plants compared with typical foods used in the study area. Numbers in brackets after each food item represent the fraction of the RDA requirement (60 mg) in each food portion. (ie. 100% RDA in food portion = 1.0, 80% RDA = 0.8 etc). Food portions for each item are given in Appendix III.

RATING OF DIETARY VALUE IN DAILY INTAKE	FOODSTUFF					
	SPINACH	FRUIT, NUT FUNGUS	BEER	STAPLE	MEAT	MILK
PRIMARY SOURCE (>80% RDA)	A.hybridus (8.45) A.hybridus (C) (1.27) P.insipidum (0.91) A.spinosus (9.05) 2 I.batatus (1.35)*	E.capensis subsp. albanensis (1.22) I.henriquesii (11.9) L.kirkii (0.92) L.petersiana (1.8) S.birrea (3.36) X.caffra (2.45)	ubuSulu (palm wine)(2.1) ubuGanu (S.birrea fruits) (2.45)	Cassava (2.0)* Melon (C.vulgaris)* (0.9)		
GOOD SUPPLEMENT (60 - 79% RDA)	I.batatus (C)1*	M.concolor (0.61) P.reclinata (0.78) M.discolor (0.62)				
MODERATE SUPPLEMENT (40 - 59% RDA)	A.spinosus (0.49)3 P.insipidum 1 C.album (0.4)	S.spinosa (0.52)				
POOR SUPPLEMENT (20 - 39% RDA)		S.madagascariensis dried pulp (0.2) S.kraussii (0.38) T.natans (0.3) S.cordatum (0.26)	uTchwala (Zulu beer)(0.33)			
INSIGNIFICANT SUPPLEMENT (<20% RDA)	A.thunbergii (0.03 - 0.16) M.balsamina (0.18) S.oleraceus (o.o2 - 0.03)	Mushroom (0.03)		Maize (C)(O)* Peanuts (O)* Cowpea (O) Sorghum (O) Pearl millet (O)* Finger millet (O)*	Mussels (C)(O) Fish(Mugil sp) (O) Beef (C)(O)	Milk (0.15)

* Cultivated plant (C) = Cooked

1 = If 50% of the vitamin C was lost during cooking (see Fox, 1966)
2 = Caldwell (1972)
[illegible]

Table 9 Thiamine. Potential value per portion of commonly collected food sources from indigenous food plants compared with typical foods used in the study area. Numbers in brackets after each food item represent the fraction of the RDA requirement (1.2 mg) in each food portion. (ie. 100% RDA in food portion = 1.0, 80% RDA = 0.8 etc). Food portions for each item are given in Appendix III.

RATING OF DIETARY VALUE IN DAILY INTAKE	FOODSTUFF					
	SPINACH	FRUIT, NUT FUNGUS	BEER	STAPLE	MEAT	MILK
PRIMARY SOURCE (>80% RDA)		L.petersiana (0.93)	uTchwala (Zulu beer, home-brewed)(0.83)	Pearl millet (0.83) Sorghum (1.33)		Milk (0.70)
GOOD SUPPLEMENT (60 - 79% RDA)	M.utilissima (0.63)*			Cowpeas (0.68) Finger millet (0.68)		
MODERATE SUPPLEMENT (40 - 59% RDA)	I.batatas (0.45)*	S.spinosa (0.43) S.birrea kernel (0.53)		Peanuts (0.53)		
POOR SUPPLEMENT (20 - 39% RDA)		Cashew nuts (0.36) V.infausta (0.23)				
INSIGNIFICANT SUPPLEMENT (<20% RDA)	C.album (0.08)	E.capensis subsp. albanensis (0.03) D.schlecteri (0.12) I.henriquesii (0.18) L.kirkii (0.13) L.petersiana (0.) P.curatellifolia (0.16) P.reclinata (0.01) S.kraussii (0.03) S.birrea (0.08) S.birrea kernel (0.05) S.madagascariensis (0.13) S.cordatum (0.06) T.natans kernel (0.08) X.caffra (0.01) Banana (0.13) Mushroom (0.1)	ubuSulu (palm wine) (0.16)	Melon (C.vulgaris) (0.01) Maize meal (0.03)	Fish (Mugil sp) (0.18) Beef (0.03)	

* Cultivated plant

foods would rather use spinaches from the leaves of cultivated plants (sweet potatoes(Ipomaea batatas), melons (Citrillus lanatus), taro (amadumbe) (Colocasia antiquorum), cassava (Manihot utilissima) or pumpkins and cabbages.

Thirdly, the mineral or vitamin composition of foods as determined by chemico-physical methods may not reflect their true nutritional value, either because the nutrients are in an unavailable form, or because they are reduced by cooking or due to the presence of other chemicals in the plant. For example nicotinic acid in cereals is unavailable in its bound form (niacytin) (Passmore et al, 1974), calcium assimilation is reduced either by high fibre intake from fruits and vegetables (Allen, 1982) or the high oxalic acid content of some Amaranthus species (Pingle and Ramasastri, 1978). Similarly, cassava (Manihot utilissima) leaf use is influenced by the level of hydrogen cyanide in the leaves (Lancaster and Brooks, 1983).

Amino-acids levels also influence the importance of indigenous plants as supplements to the starchy staple diet. High tryptophan and lysine levels in some spinaches (Lewis et al, 1971, Shanley and Lewis, 1969) high tryptophan levels in Sclerocarya kernels (Ferrao, 1960) and high lysine levels in palm wine (Nash and Bornmann, 1973), increase their dietary importance disproportionately in comparison to foods with a high crude protein content that are deficient in these amino acids.

More data is therefore needed on the amino-acid content of indigenous foodstuffs to add to the work done by Lewis et al, 1971, Shanley and Lewis, 1969 and Santos-Oliviera and Carvalho, 1975. Amino-acid analyses of Parinari curatellifolia, and Trapa natans kernels would be particularly valuable in this regard.

Additional analyses also need to be done on the carotene composition of Trichilia emetica arils and Phoenix reclinata fruits, a more detailed analysis of Pentarrhinum insipidum leaves to update the data in Quin (1959) and analyses of Asystasia gangetica, Pyrenacantha scandens, Commelina benghalensis, Thunbergia dregeana, Cucumella cinerea and Deinbollia oblongifolia leaves. More data on the effects of cooking on nutrient values is also required.

Despite these limitations it is considered that these data have considerable practical value for the local primary health care programme and for conservation of plant resources outside designated reserves. They also highlight the need for caution on the proposal by Tinley and van Riet (1981) that S.birrea kernels be produced for commercial sale as this is a major protein source for people during drought periods (see Table 4).

In the past, use of fire and clearing for agriculture added to habitat and species diversities by creating a mosaic of habitat types in various stages of recovery after disturbance. Population densities were lower than today and fallow periods were longer. When clearing was done, large specimens of useful tree species were not cut out but were conserved, either for their fruits (Annona senegalensis, Cordia ovalis, Canthium inerme, Lagynias lasiantha, Vangueria infausta), the shade they provided (Albizia adianthifolia) or both (Dialium schlechteri Manilkara discolor, Manilkara concolor, Strychnos spinosa, Strychnos madagascariensis and Trichilia emetica). Private rights to fruits from these trees was a major incentive for their conservation, while fruits from trees in undisturbed vegetation were common property. A high rate of population increase (2.67 % per annum)(Bruton, 1980)) and the high concentration of people settled at crossroads and around stores have led to increasing breakdown of this diversity. With increasing trampling by cattle or agricultural clearing, the availability of spinaches and certain woody fruit bearing species (Eugenia capensis subsp. albanensis, Eugenia mossambicensis, Parinari curatellifolia and Salacia kraussii) is increasing while mature plant communities are disappearing from these areas. Conservation and dispersal of edible tree species by man has undoubtedly had a major influence on the vegetation of the area in the past. It has also buffered the effects of agricultural clearing on the habitat, retaining nutritionally important plant resources for dietary use during "seasonal famine" and drought periods. The rejection of traditional conservation practices and of indigenous plants as a source of food are sociological changes that are inappropriate to a low carrying capacity and low agricultural potential area.

What is necessary is for traditional conservation practices to be reinforced by promoting the value of indigenous plants through the primary health care programme (which would have more local credibility than the conservation department). In particular, the value of indigenous trees and shrubs needs to be stressed. These are not only a source of fruits but of other resources of dietary importance. Live trees are a source of Saturniid larvae, (Sclerocarya birrea, Syzygium cordatum) and honey from nectar (Dovyalis caffra, S.birrea, S.cordatum, Trichilia emetica, Ziziphus mucronata) and pollen (S.birrea, T.emetica). Dead trees (or live trees with heart rot) are equally useful. Pappea capensis, Manilkara concolor, M.discolor and Dialium schlechteri are all susceptible to heart-rot, commonly providing natural bee-hives (Tinley, 1964, this study) and dead S.birrea trees are a source of Cerambycid larvae.

Doughty (1979) and Grivetti (1979, 1980, 1981) both stress the importance of maintaining a diverse resource base for adequate human nutrition during drought periods in rural areas with marginal potential. Maintenance of habitat and species diversity is also a conservation objective (IUCN, 1980). However, rural people at a subsistence level cannot be expected to make all of the short term sacrifices for long term benefits of conservation. Industrial and rural sectors of society both stand to benefit from the maintenance of habitat and species diversity. For example _Eugenia capensis_ subsp. _albanensis_, _Garcinia livingstonei_, _Inhambanella henriquesii_, _Landolphia kirkii_, _L.petersiana_, _Manilkara concolor_, _M.discolor_, _Salacia kraussii_, _S.leptoclada_ and _Ximenia caffra_ all have potential as future crop plants. The potential of _Sclerocarya birrea_ for this purpose has already been recognised and a genetic selection programme is in progress (von Teichmann, 1983). It is in the interests of both groups to work towards maintenance of this diversity.

APPENDIX TABLE 1

A list of indigenous or naturalised (Commelina benghalensis and Sonchus oleraceus) plant species recorded as a source of edible fruits, leaves, kernels, sap or shoots. Two categories of plants should be noted. Firstly those that were edible but were excluded for a particular reason and secondly species that were inedible or were said to be inedible by informants although recorded in other ethno-botanical studies as being edible.

a) Edible species excluded were : Dodonea viscosa because it was probably not indigenous to the area. Trapa natans var. bispinosa kernels which were well known in the area, but were not recorded from wetlands on the coastal plain although they were commonly collected on the Pongolo floodplain. Ficus burtt-davyi, F.verruculosa, F.vogelii, F.stuhlmannii, F.tremula and F.trichopoda fruits which were tastless and were not recorded being eaten in the area.

b) Species that were inedible (eg. Cordyla africana fruits, which have a terrible taste) or said to be inedible by local people contrary to the records of the following authors from other parts of southern Africa were :

   i) Leaves used for spinaches : Acalypha glabrata, Pavetta lanceolata and Trema orientalis (Palmer and Pitman, 1972), Apodytes dimidiata, Cissampelos hirta and Dissotis canescens (Fox and Norwood-Young, 1982, and leaves of an unidentified Aloe species (Lubbe et al, 1973).

ii) Fruits of Drypetes arguta, Myrica serrata and Rothmannia globosa (Palmer and Pitman, 1972), Bridelia cathartica, B.micrantha, Cordyla africana and Gardenia thunbergii (Fox and Norwood-Young, 1982).

iii) Roots or rhizomes of Phragmites australis (Watt and Beyer-Brandwijk, 1962), Hemarthria altissima and Imperata cylindrica (Fox and Norwood-Young, 1982).

Confirmation is also needed on whether the fruits of Catunaregam spinosa and Coddia rudis which were recorded by Pooley (1978, 1980) as eaten by Tembe-Thonga people in the Ndumu area are eaten as food or for medicinal purposes (to induce vomiting). Tembe-Thonga people on the coastal plain were often unable to distinguish between infertile specimens of C.spinosa and Plectroniella armata. The availability and common occurrence of these species on the coastal plain is also shown in the table. Vegetation types (1-24) follow the classification of the Loxton et al (1969) vegetation map, with the addition of a category for disturbed areas. An (X) shown for species in disturbed areas denotes that their occurrence depends on their being conserved in agricultural fields as a fruit source. Numbers 1-2 represent the following vegetation types:

1 = Disturbed soils

2 = Coast Forest

3 = Coast Dune Short Forest and Thicket

4 = *Podocarpus* - *Ficus* Forest

5 = *Podocarpus* - *Dialium* - other species Medium and Tall Thicket

6 = *Newtonia* - other species Medium to Tall Sand Thicket

7 = *Albizia* - other species Medium to Tall Sand Thicket

8 = *Hymenocardia* - *Dialium* - other species Medium to Tall Sand Thicket

9 = *Acacia* - *Dialium* - Medium and Tall Thicket

10 = *Albizia* - *Dialium* Medium and Tall Thicket

11 = *Acacia burkei* - other species Open Woodland

12 = *Acacia karroo* - *Spirostachys* Open Woodland

13 = *Acacia karroo* - *Spirostachys* Open Woodland on Ternutaria

14 = *Acacia burkei* - *Syzygium cordatum* Open Woodland

15 = *Terminalia* - other species Open Woodland

16 = *Terminalia* - *Syzygium cordatum* Coast Open Woodland

17 = *Acacia burkei* - other species shrub Open Woodland

18 = *Trichilia* Coast Wooded Grassland

19 = *Hyphaene* palmveld

20 = Dwarf *Parinari* grassland

21 = Hygrophilous grassland

22 = Swamp Forest

23 = Mangrove swamp forest

24 = Reed, sedge, hygrophilous grass swamp

SPECIES AND PART EATEN		SEASON AVAILABLE	VEGETATION TYPE D=disturbed areas P=palmveld GRL=coastal grassland WTL=wetland																								VOUCHER SPECIMEN
G=gum F=fruit L=leaves F(k)=fruit kernel S=shoot sp=sap			D	COAST FOREST OR THICKET				SAND FOREST/ THICKET					SAVANNA								P	GRL		WTL			
		J F M A M J J A S O N D	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Acacia burkei	G	? ?											X	X	X	X	X	X									
Acacia nilotica	G	? ?											X	X	X												
Achyranthes sp	L		X																								
Amaranthus hybridus	L		X																								C. 518
Amaranthus spinosus	L		X																								
Amaranthus thunbergii	L		X																								C. 517
Annona senegalensis	F				X											X	X	X	X	X	X						
Antidesma venosum	F				X								X	X	X	X	X	X	X	X	X						S-S 251
Asystasia gangetica	L		X	X	X																						C. 700, B 196
Asystasia schimperi	L		X	X	X																						
Balanites maughamii	F,F (K)			X	X	X	X	X	X	X	X	X															
Berchemia discolor	F							X					X		X												C. 513
Berchemia zeyheri	F													X													S-S 150
Bidens pilosa	L		X																								
Canthium inerme	F		(X)		X	X	X									X	X	X	X	X							
Canthium obovatum	F				X	X	X	X	X	X	X	X				X	X	X	X	X							
Canthium setiflorum	F							X	X	X	X	X															C. 520
Canthium spinosum	F							X	X	X	X	X															C. 514
Capparis tomentosa	F														X												
Carissa bispinosa	F			X	X			X	X	X	X	X															
Carissa macrocarpa	F				X																						
Chenopodium album	L		X																								
Chenopodium opulifolium	L		X																								
Chrysanthemoides monelifera	F		X		X	X	X											X	X	X							
Coccinia hirtella	L	?	X																								
Coccinia rehmanni var. littoralis	L	?	X		X																						P. 216
Commelina benghalensis	L		X																								C. 683
Commiphora neglecta	R			X	X	X	X	X	X	X	X	X						X	X	X							SS 241
Cordia caffra	F														X												P. 1246
Cordia ovalis	F		(X)					X	X	X	X	X	X	X	X	X	X										P. 683
Cucumella cinerea	L		X																								C. 406, C. 684
Deinbollia oblongifolia	F, L		X																								
Dialium shlecteri	F		(X)	X	X	X	X	X	X	X	X	X	X				X										G. 492
Diopyros lyciodes	F												X	X	X	X	X	X	X	X	X	X					

SPECIES AND PART EATEN

G=gum F=fruit L=leaves F(k)=fruit kernel S=shoot sp=sap

SEASON AVAILABLE (J F M A M J J A S O N D)

VEGETATION TYPE

D=disturbed areas P=palmveld GRL=coastal grassland WTL=wetland

Species	Part eaten	Season available	D 1	Coast forest or thicket 2	3	4	5	Sand forest/ thicket 6	7	8	9	10	Savanna 11	12	13	14	15	16	17	18	P 19	GRL 20	21	WTL 22	23	24	Voucher specimen
Dovyalis caffra	F														X												
Dovyalis longispina	F			X	X	X	X	X	X	X	X	X															P. 286
Ehretia amoena	F														X												T. 332
Ehretia rigida	F									X	X	X			X												T & W 30
Epinetrum delagoense	F												X	X	X	X	X	X	X	X	X	X					T. 989
Euclea divinorum	F			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Eugenia capensis subsp. albanensis	F												X	X	X	X	X	X	X	X	X	X					P. 233
Eugenia capensis subsp. capensis	F			X	X																						P. 2127
Eugenia mossambicensis	F												X	X	X	X	X	X	X	X	X	X					P. 803, 421
Ficus capensis	F																							X			T. 235
Garcinia livingstonei	F																X	X	X	X							
Gardenia amoena	F							X	X	X	X	X															C. 399
Grewia caffra	F			X	X	X	X	X	X	X	X	X															P & H 743
Grewia microthysa	F							X	X	X	X	X															T. 428
Heliotropium indicum *	L	?																								?	F 96
Hoslundia opposita	F																		X	X	X	X					
Hyphaene natalensis	F(p),S,Sp																	X			X	X					
Inhambanella henriquesii	F			X	X	X	X																				
Kraussia floribunda	F				X							X		X						X							C. 372
Lagynias lasiantha	F		(X)					X	X																		C. 402
Landolphia kirkii	F			X	X	X	X	X	X	X	X	X															P. 797
Landolphia petersiana	F			X	X	X	X						X			X	X	X	X	X	X	X					Gw. 206
Lantana rugosa	F												X	X	X	X	X	X	X	X		X					P. 1491
Limeum sp	L	? ?	X		X	X	X																				
Manilkara concolor	F		(X)	X	X	X	X	X	X	X	X	X															
Manilkara discolor	F		(X)	X	X	X	X	X	X	X	X	X															
Mimusops caffra	F			X	X	X	X																				
Mimusops obovata	F			X	X	X	X																				
Monodora junodii	F					X	X	X	X	X	X	X															C. 581, 582
Momordica balsamina	L,F	?	X																								C. 388
Morus mesozygia	F			X		X																					M. 3183
Nymphaea capensis	R																									X	E. 2565
Nymphaea lotus	R																										P. 765
Ophioglossum polyphyllum	L		X																			X					C. 657

SPECIES AND PART EATEN		SEASON AVAILABLE	VEGETATION TYPE																								VOUCHER SPECIMEN
G=gum F=fruit L=leaves F(k)=fruit kernel S=shoot sp=sap		J F M A M J J A S O N D	D	COAST FOREST OR THICKET				SAND FOREST/ THICKET					SAVANNA								P	GRL		WTL			
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Pappea capensis	F													X													
Parinari curatellifolia subsp. mobola	F.(p,k)															X	X	X	X	X	X	X					B. 588
Pavetta catophylla	F							X	X	X	X	X															T. 414
Pavetta schumannia	F							X	X	X	X	X															P. 787
Pentarrhinum insipidum	L		X				X						X	X	X	X	X	X	X	X							
Phoenix reclinata	F, S														X			X		X	X						
Plectroniella armata	F												X				X										C. 759
Pyrenacantha scandens	L		X																								
Rhoicissus digitata	F		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
Rhus guenzii	F							X	X	X	X	X	X	X													
Ruellia ovata	L		X																								K. 98
Rorippa fluviatilis	L																									X	
Salacia kraussii	F													X	X		X	X	X	X	X	X	X				B. 493
Salacia leptoclada	F							X	X	X	X	X															C. 500
Sarcostemma viminale	F, S			X	X		X	X	X	X	X	X															M. 3170
Sclerocarya birrea	F, F (k)		(X)										X	X	X	X	X	X	X	X							
Sonchus oleraceus	L		X																								M. 4610
Strelitzia nicolai	F			X	X																						
Strychnos madagascariensis	F		(X)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
Strychnos spinosa	F		(X)	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
Synaptolepis kirkii	F		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							B. 629
Syzygium cordatum *	F			X	X											X		X		X						X	
Tabernaemontana elegans	Sap, F			X	X	X	X	X	X	X	X	X														X	
Thilachium africanum *	L							X	X	X	X	X															M. 3184
Thunbergia dregeana	L		X			X	X			X	X	X															C. 425, 433
Trachyandra sp	L		X													X		X		X							
Trichilia emetica	F (aril)		(X)	X	X	X	X						X	X	X	X	X	X	X	X							
Uvaria caffra	F			X	X	X	X	X	X	X	X	X															SS 281
Uvaria lucida	F							X	X	X	X	X															C. 472
Vangueria chartacea	F					X	X	X	X	X	X	X															T. 900
Vangueria cyanescens	F							X	X	X	X	X															P. 916
Vangueria infausta	F				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Vitex patula	F							X	X	X	X	X															SS 288
Voacanga thouarsii	F																									X	
Ximenia caffra	F				X			X	X	X	X	X			X												B. 669
Xylotheca kraussiana	F			X	X	X	X	X	X	X	X	X															P. 422
Ziziphus mucronata	F			X	X	X	X								X												

D=disturbed areas P=palmveld GRL=coastal grassland WTL=wetland

Appendix Table II Protein, calcium, riboflavin, niacin, vitamin C and thiamine content of foods commonly eaten in the study area. Data in this table has been compiled from various sources, including the analyses done for this study (Table 3).

FOODSTUFF	SPECIES	g/100 g	mg/100 g					SOURCE
		Protein	Ca	Ribof	Niacin	Vit. C	Thiam.	
SPINACH	Amaranthus hybridus	4.7	-	-	1.27	25.4-(C)	-	6, 12
	(Cooked =(C))					169.0		12
(IMIFINO)	Amaranthus spinosus	6.0	377*	-	1.13	9.8	-	2, 11
	Amaranthus thunbergii	5.4	220-730	-		0.6 - 3.3	-	1
	Asystasia schimperi	4.9	-	-	1.1	-	-	6
	Bidens pilosa	2.3 -4.2	292*	0.23	0.78	-	-	6,7,8,11,15
	Chenopodium album	4.7	239	0.23	0.71	8.0	0.03	15
	Colocasia antiquorum**	6.1	129.0	-	0.88	-	-	8, 11
	Ipomaea batatas**	4.2	360	0.24	1.28-1.7	27-107	0.18	3, 10
	Lagenaria vulgaris**	2.3	80	-	-	-	-	3
	Momordica balsamina	3.7	302*	-	-	3.6	-	2, 11
	Manihot utilissima**	7.0	303	0.6	2.4	8	0.25	5
	Ophiglossum polyphyllum(•)	3.6	-	-	1.3	-	-	6, 7, 8
FRUIT (INDIGENOUS)	Eugenia capensis albanensis	0.8	31	0.01	0.35	24.4	0.01	this study
	Dialium schlecteri	4.8	36.8	0.06	2.89	-	0.29	this study
	Inhambanella henriquesii	1.4	41.8	0.06	1.10	238	0.07	this study
	Landolphia kirkii	1.3	2.31	0.05	1.12	18.4	0.05	this study
	Landolphia petersiana	0.9	4.29	0.01	1.15	36.1	0.04	this study
	Manilkara concolor	-	-	-	-	12.1	-	this study
	Manilkara discolor	2.1	81.9	0.04	0.35	1.4	0.04	this study
	Parinari curatellifolia	1.6	89.5	0.27	0.77	47.1	0.01	4
	Phoenix reclinata	4.1	41.0	0.03	1.48	47.1	0.03	this study
	Salacia kraussii	1.1	10.4	0.02	0.77	7.5	0.01	this study
	Sclerocarya birrea	0.5	6.2	0.05	0.25	194	0.03	4 , 17
	S. birrea kernel	30.9	106	0.12	0.71		0.42	4
	Strychnos madagascariensis (dried pulp)	-	48.9	0.04	1.55	12.0	0.10	4
	Strychnos spinosa	1.4	65.8	0.07	1.02	10.3	0.17	4
	Syzigium cordatum	0.6	30.1	0.23	0.15	5.1	0.02	4
	Trapa natans	4.7	20	0.07	0.6	9	0.05	3
	Vangueria infausta	2.1	38.6	0.01	0.71	-	0.09	this study
	Ximenia caffra	2.3	2.17	0.04	0.54	55.9	0.04	this study
FRUIT (EXOTIC)	Mango	0.7	10	0.05	1.1	35	-	13
	Banana	1.1	8	0.06	0.7	10	0.05	13
	Cashew nuts	17.2	38	0.25	1.8	-	0.43	13
MUSHROOM	Edible mushroom (raw)	2.7	6	0.46	4.2	3	0.10	13
BEER	ubu Sulu (Palm wine)	0.2	0.9	0.01	0.28	6.3	0.01	16
	ubu Ganu (Marula beer)	0.18	4.1	-		49.0		4
	uTchwala (Zulu beer)	0.7	1.0	0.06	0.5	1.0	0.05	13
STAPLE	Maize meal (cooked)	1.7	0	0.01	0.1	0	0.01	13
	Peanuts (A.hypogaea)	26.2	72	0.13	17.2	0	0.32	13
	Jugo bean (V.subterranea)	18	55	0.1	2.0	-	-	3
	Cowpea (V.sinensis)	24.6	70	0.85	-	0	0.41	5
	Pearl millet (P.typhoideum)	11.6	42	0.16	3.2	0	0.33	3
	Finger millet (E.coracana)	7.3	344	0.1	1.1	0	0.42	3
	Sorghum (S.dochna)	10.4	32	0.19	3.9	0	0.53	3, 14
	Cassava tuber(M.utilissima)	0.8	36	0.04	0.7	40		3
	Melon (C.vulgaris)	1.4	25	0.08	0.3	18	0.04	3
MEAT	Fish (Mugil species)	20.7	56	0.15	4.6	0	0.07	9
	Beef (Stewing steak combined with fat)	30.9	15	0.33	3.6	0	0.03	13
	Mussels (boiled)	17.2	200	-	-	0		13
MILK	Whole milk	26.3	912	1.21	0.6	9	0.28	13
INSECTS	Ants (Carebara vidua) ♂	25.2	-	-	-	-	-	2
	(amaHlwabusi) ♀	7.4	-	-	-	-	-	2
	Saturniid caterpillars(dried)	55	270	2.0	11.2	-	-	3
	Gonimbrasia belina	19.1	-	-	-	-	-	2
	Locusts (fried)	30.5	149	-	-	-	-	3

REFERENCES: 1. Levy et al (1936). 2. Quin (1959). 3. Fox (1966). 4. van der Merwe et al (1967). 5. FAO (1968). 6. Lewis et al (1971). 7. Shanley and Lewis (1969. 8. Hennessy and Lewis (1971). 9. FAO (1972). 10. Caldwell (1972). 11. Santos-Olivera and Carvalho (1975). 12. Gomez (1982). 13. Gouws and Langenhoven (1982). 14. Fox and Norwood-Young (1982). 15. Wehmeyer and Rose (1983). 16. Cunningham and Wehmeyer, in prep. 17. Wehmeyer pers. comm. (1984)

* Converted from mg/100 g (dry wt) to mg/100 g (fresh wt)

** Cultivated spinaches

(•) Identified as O.engelmannii for Lewis et al (1971), Hennessy and Lewis (1969) but this species does not occur in southern Africa (Antnony pers comm).* Likely to be O.polyphyllum which is common in Natal (see Cunningham 556 and 657 NU)

Note: In this table, 0 signifies that none of the nutrient was detectable and a dash shows that no data was available.

* Mrs N Anthony
Bolus Herbarium
University of Cape Town
RONDEBOSCH 7700

Appendix III

The quantities of dietary nutrients contained in commonly used portions of the various foodstuffs were determined from the data in Appendix Table II and daily intake or meal ration figures derived from published work (Quin, 1959, Coleman et al, 1975 and Oomen and Grubben, 1977) and discussions with local people. The quantities (fresh weight) assumed to constitute commonly used portions were as follows:

Spinaches:	(*imifino*) 300 g (see Quin, 1959, Oomen and Grubben, 1977)
Fruits:	*Parinari curatellifolia* 200 g
	Phoenix reclinata 100 g
	Strychnos madagascariensis pulp (dried) 150 g
	Sclerocarya birrea kernels 150 g
	Trapa natans kernels 200 g
	Cashew (*Anacardium occidentale*) nuts 100 g
	All other fruits 300 g (see Quin, 1959 for *meal ration* portions of *Dovyalis caffra*, *Sclerocarya birrea*, *Vangueria infausta* and *Ximenia caffra* fruits)
Beer:	2 litres (and assumed that 1 mℓ = 1 g)

Staple:	Maize meal 400 g (see Colman et al, 1975)
	Pulses 300 g (see Quin, 1959)
	Sorghum, Pearl Millet, Cassava 300 g
Finger Millet:	200 g
Meat:	Fish 300 g
	Beef 100 g
	Mussels 200 g
Whole Milk:	300 g
Insects:	*Carebara vidua* (male & female ants 30 g (Quin, 1959)
	Saturniid larvae (caterpillars) 240 g (Quin,1959)
	Locusts 100 g (Quin,1959)
Mushrooms:	50 g

ACKNOWLEDGEMENTS

I wish to thank the Director, KwaZulu Bureau of Natural Resources for permission to carry out this study and the financial support from the Cooperative Scientific Programmes section of the Council for Scientific and Industrial Research (CSIR) whilst writing up this project.

I am also grateful to Mr A S Wehmeyer, Mrs G Armbruster, Mr R Bagnari, Mrs A Fourie, Miss T Saunders, Mrs S Smit and Miss E Strydom of the National Food Research Institute of the CSIR for doing the nutritional analyses, to Mr B R Gwala, Mr A Ntombela and the late Mr A Vilane for doing the interviews and to Professor O A M Lewis, Professor E J Moll, Mr A S Wehmeyer and Dr D Prozesky for comments on the manuscript.

LITERATURE CITED

Allen, L H 1982. Calcium bioavailability and absorption: a review. Am J Clin Nutr 35:783-808

Anon 1979. Revised Recommended Dietary Allowances. J Am Dietet A 75:623-625

Beyers, M J C, M L Langenhoven, J P du Plessis, J J Ferreira, A S P Swanepoel, P C J Jordaan. 1984. Nutritional value of diets of Blacks in Ciskei. S Afr Med J 65:338-345

Bruton, M N. 1980. Conservation and Development in Maputaland in "Studies on the Ecology of Maputaland p. 497-529 M N Bruton and K H Cooper, ed Cape and Transvaal Printers, Cape Town

Bruton, M N and K H Cooper. 1980. Studies on the Ecology of Maputaland. Cape and Transvaal Printers, Cape Town

Caldwell, M J. 1972. Ascorbic acid content of Malaysian leaf vegetables. Ecol Food Nutr 1:313-317

Coates-Palgrave, K H. 1977. Trees of Southern Africa, C Struik, Cape Town

Colman, N, E A Barker, M Barker, R Green and J Metz. 1975. Prevention of folate deficiency by food fortification IV. Identification of target groups in addition to pregnant women in an adult rural population. Am J Clin Nutr 28:471-478

Cunningham, A B in prep a. A list of plant species used by rural people in Maputaland, South Africa

Cunningham, A B in prep b. Palm wine tapping in Maputaland, South Africa II. Yields, individual profits and carrying capacity

Cunningham, A B and A S Wehmeyer, in prep. The nutritional value of _Hyphaene natalensis_ and _Phoenix reclinata_ palm wine

Doughty, 1979. The dangers of reducing the range of food choices in developing countries. Ecol Food Nutr 8:275-283 FAO 1968

FAO 1968. Food composition table for use in Africa. Food and Agric Organisation. Rome and U S Dept Health, Education and Welfare.

FAO 1972. Food composition table for use in East Asia. Food and Agric Organisation. Rome and U S Dept Health, Education and Welfare

Felgate, W S 1965. An ecological study of the Tembe-Thonga people. Unpublished report 167 pp. E J Krige ed.

Felgate, W S 1982. The Tembe-Thonga of Natal and Mozambique: an ecological approach. Occasional Publications No.1 Dept of African Studies, University of Natal, Durban.

Ferrao, J X 1960. N'gongo (Sclerocarya sp.). Agronomia Angolana (Luanda). 12:84-86.

Fleuret, P and A Fleuret 1980. Nutrition, Consumption and Agricultural Change. Human Organisation. 39:250-260.

Fox, F W 1966. Studies on the Chemical Composition of Foods commonly used in Southern Africa. South African Institute for Medical Research, Johannesburg.

Fox, F W and M E Norwood-Young 1982. Food from the Veld. Delta Books, Johannesburg.

Gomez, M I. Sources of vitamin C in the Kenya diet and their stability to cooking and processing. Ecol Food Nutr 12:179-184.

Gouws, E and M L Langenhoven 1982. National Research Institute for Nutritional Diseases Food Composition Tables. S A Medical Research Council. Parow, South Africa. 100 pp.

Grivetti, L E 1979. Kalahari Agro-Pastoral-Hunter-Gatherers. The Tswana example. Ecol Food Nutr 7:235-256.

Grivetti, L E 1980. Agricultural development : present and potential role of edible wild plants. Part 2. Sub-Saharan Africa. Report to USAID. 142 pp

Grivetti 1981. Perspectives on dietary utilization of wild plants nutritional status and agricultural development. International Geographical Union Commission on Rural Development, Symposium on Rural Development : Theory and Practice. Fresno, California. April 23-25, 1981

Groenewald, G, M L Langenhoven, M J C Beyers, J P du Plessis, J J Ferreira and S J van Rensburg. 1981. Nutrient intakes among rural Transkeians at risk for oesophageal cancer. S Afr Med J 60:964-967

Heard, C R C 1955. Palm wine in human nutrition. Proc Nutr Soc 14:xi-xii

Hegstead, D M 1972. Problems in the use and interpretation of the Recommended Dietary Allowances. Ecol Food Nutr 1:255-265

Hennessy, E F and C A M Lewis 1971. Anti-Pellagragenic properties of wild plants used as dietary supplements in Natal (South Africa). Pl Fds Hum Nutr 2:75-78

IUCN 1980. World Conservation Strategy. International Union for Conservation of Nature and Natural Resources, Morges, Switzerland

Junod, H A 1927. The Life of a South African Tribe. Reprint by University Books, Inc, New York, 1962

Lancaster, P A and J E Brooks 1983. Cassava leaves as human food. Econ Bot 37:331-348

Levy, L F, D Weintraub and F W Fox 1936. The food value of some common edible leaves. S Afr Med J 10:699-707

Lewis, O A M, D M G Shanley and E F Hennessy. 1971. The leaf protein nutritional value of four wild plants used as dietary supplements by the Zulu. p. 95-102 in Proteins and Food Supply in the Republic of South Africa. J W CLaasens and H G Potgieter ed, A A Balkema, Cape Town

Liengme, C A 1983. A survey of ethno-botanical research in Southern Africa. Bothalia 14:621-629

Lind, G P 1984. Settlement, Food Production and Consumption patterns in a rural community in KwaZulu. Progress report, January 1984. Institute of Natural Resources, University of Natal, Pietermaritzburg, South Africa

Loxton, R F, Hunting and Associates. 1969. Development Plan for Maputaland. Unpublished Map series (1:100 000), Dept Bantu Administration and Development

Lubbe, A M, C D Elphinstone and S A Fellingham 1973. Mseleni Joint Disease: Food and Water Supplies. S Afr Med J 47:2225-2233

Margo, G,Y Baroni, G Wells, R Green and J Metz. 1978. Protein energy, malnutrition and nutritional anaemia in pre-school children in rural KwaZulu. S Afr Med J 53:21-26

Moll,E J 1978. The vegetation of Maputaland - a preliminary report on the plant communities and their present and future conservation status. Trees in S Afr 29:31-58

Nash,L J and C H Bornmann. 1973. Constituents of ilala wine. S Afr J Sci 69:89-90

Oomen, H A P C and G J H Grubben 1977. Tropical leaf vegetables in human nutrition, Koninklijk voor de Tropen, Amsterdam

Palmer, E and N Pitman 1972. Trees of Southern Africa. A A Balkema, Cape Town

Passmore, R, M R Narayana, B M Nicol, G H Beaton and E M de Mayer. 1974. Handbook on nutritional requirements. FAO Nutritional Studies No. 28. United Nations Food and Agricultural Organisation, Rome

Pingle, U and B V Ramasastri 1978. Absorption of calcium from a leafy vegetable rich in oxalates. Br J Nutr 39:119-125

Pooley, E S 1978. A checklist of the plants of Ndumu Game Reserve. Jl S A Bot 44:1-54

Pooley, E S 1980. Some notes on the utilization of natural resources by the tribal people of Maputaland. p. 467-479 in "Studies on the Ecology of Maputaland", M N Bruton and K H Cooper, ed Cape and Transvaal Printers, Cape Town

Poultney, C 1980. Subsistence and utilization of resources by inhabitants of the Mthikeni/Nsimbi pans region of the Pongolo floodplain. Human Sciences Research Council Report, Pretoria, South Africa

Quin, P J 1959. Food and Feeding Habits of the Pedi. Witwatersrand University Press, Johannesburg

Santos-Oliviera, J and F M de Carvalho 1975. Nutritional value of some edible leaves used in Mozambique. Econ Bot 29:255-263

Scudder, T 1971. Gathering among African woodland savannah cultivators. A Case Study : The Gwembe Tonga. University of Zambia Institute Studies. Zambian Papers No. 5. University of Zambia, Lusaka

Seagrief, S C 1980. Seaweeds of Maputaland. p. 18-41 in "Studies on the ecology of Maputaland". M N Bruton and K H Cooper, ed, Cape and Transvaal Printers, Cape Town

Shanley, B M G and O A M Lewis 1969. The protein nutritional value of wild plants used as dietary supplements in Natal (South Africa). Pl Fds Hmn Nutr 1:253-258

Tinley, K L 1964. Summary of an ecological survey of Ndumu Game Reserve, Tongaland. December 1963 - February 1964. Unpublished report, 33 pp. Natal Parks Board, Pietermaritzburg

Tinley, K L and W R van Riet 1981. Tongaland : zonal ecology and rural land use proposals. Unpublished report, Dept Co-operation and Development, Pretoria, South Africa.

Van der Merwe, A le R, I M Burger and A S Wehmeyer 1967. Suid-Afrikaanse Veldkosse : I. Makatini vlakte, Noord Natal. National Food Research Institute, Council for Scientific and Industrial Research, Pretoria, South Africa von Teichman, I. 1983. Notes on the distribution, morphology, importance and uses of the indigenous Anacardiaceae. 2. The importance and uses of Sclerocarya birrea (the marula). Trees in S Afr 35:1-7

Watt, J M and M G Breyer-Brandwijk. 1962. Medicinal and Poisonous Plants of Southern and Eastern Africa, 2 ed, Edinburgh and London

Wehmeyer, A S 1966. The nutrient composition of some edible wild fruits found in the Transvaal. S Afr Med J. 40:1102-1104

Wehmeyer, A S and E F Rose 1983. Important indigenous plants used in the Transkei as food supplements. Bothalia 14:613-615